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Index to Advertisers and Classified Index Following Reading Matter.

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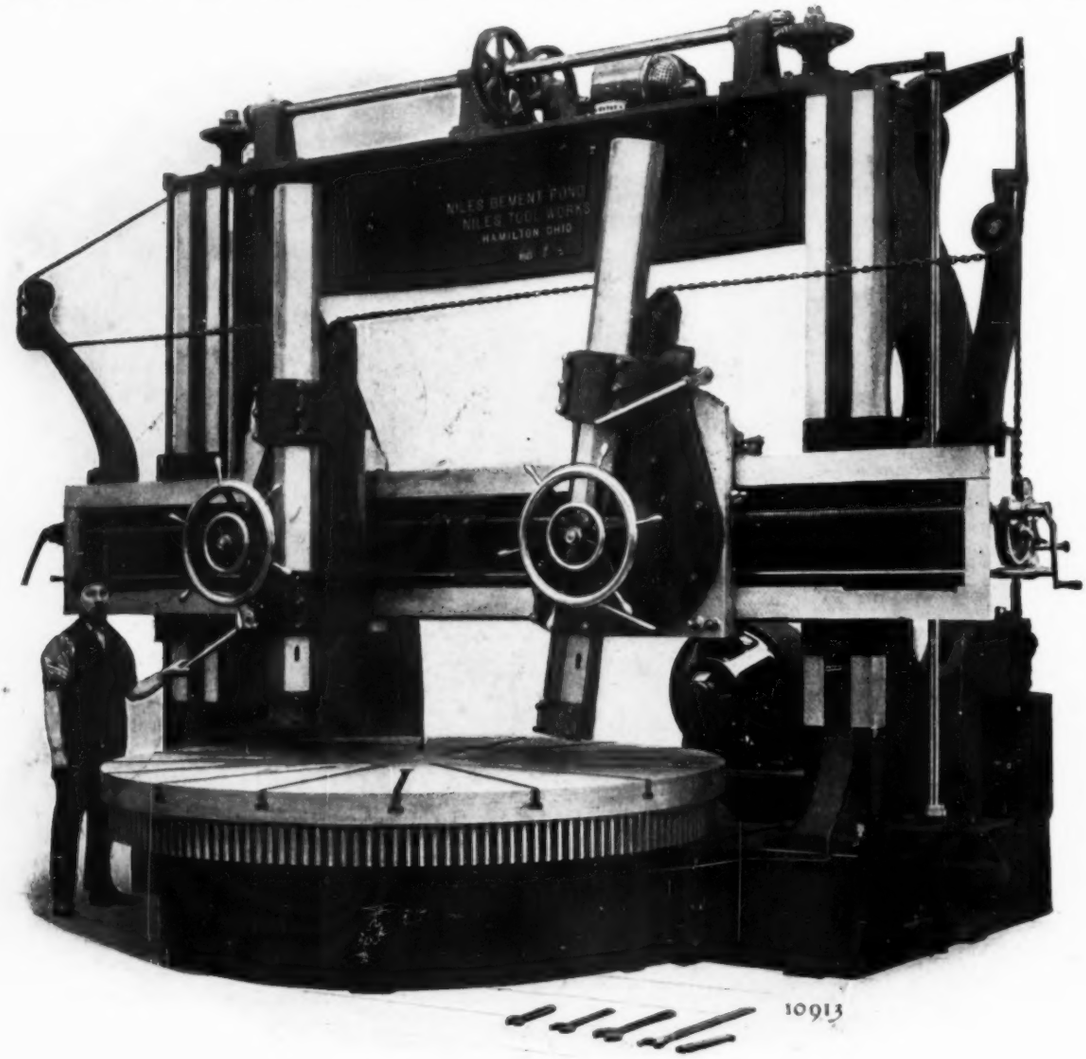

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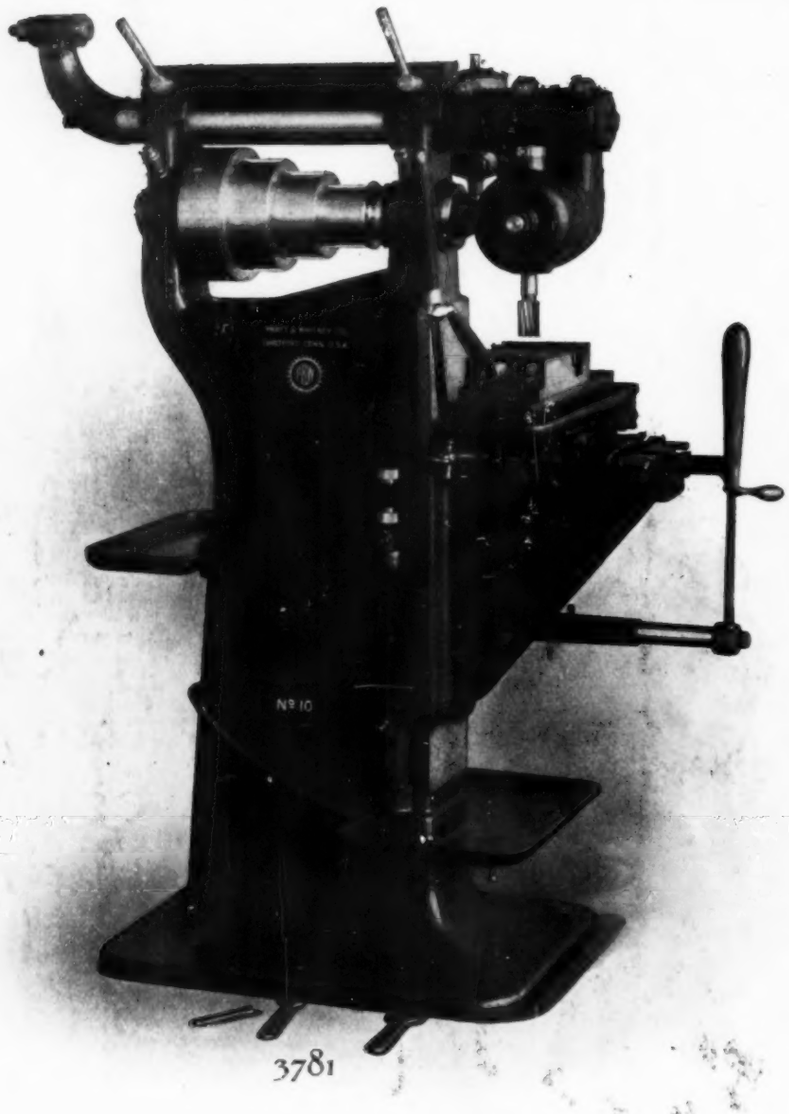

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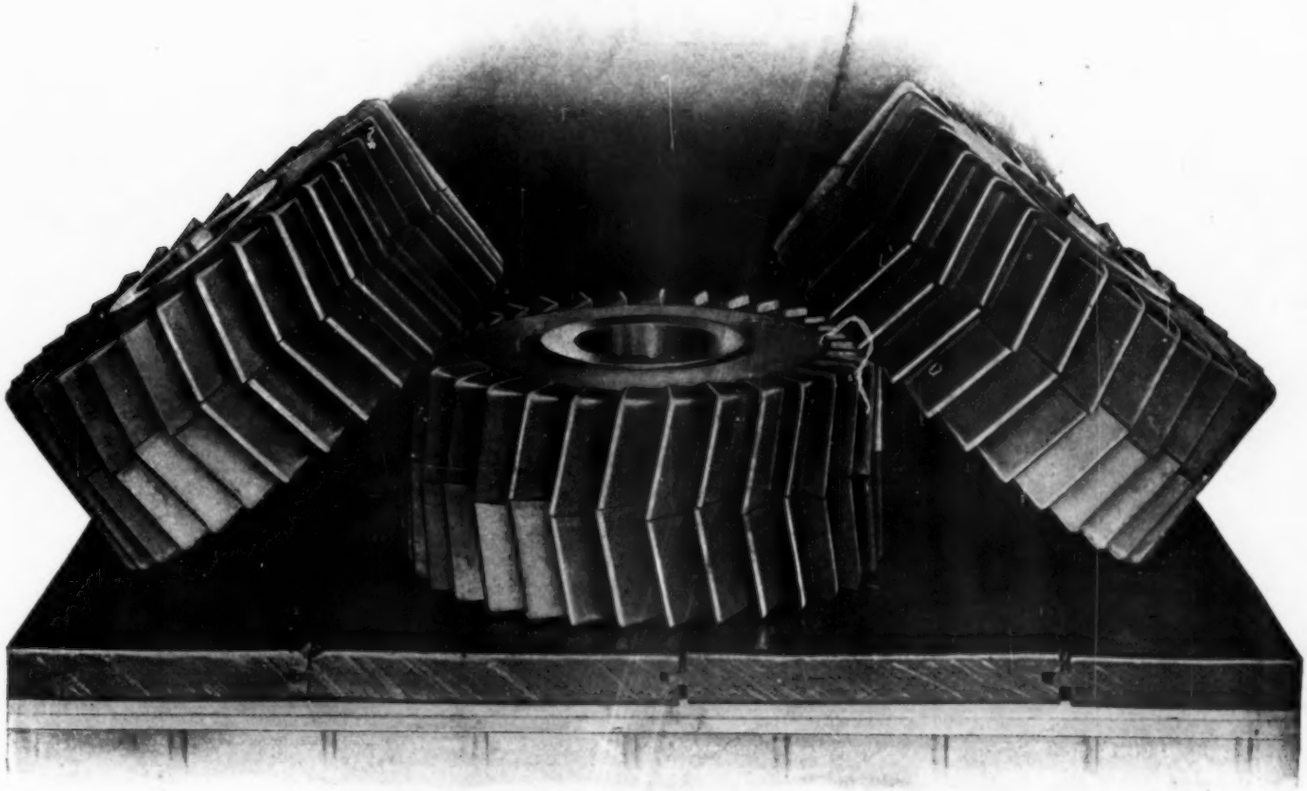

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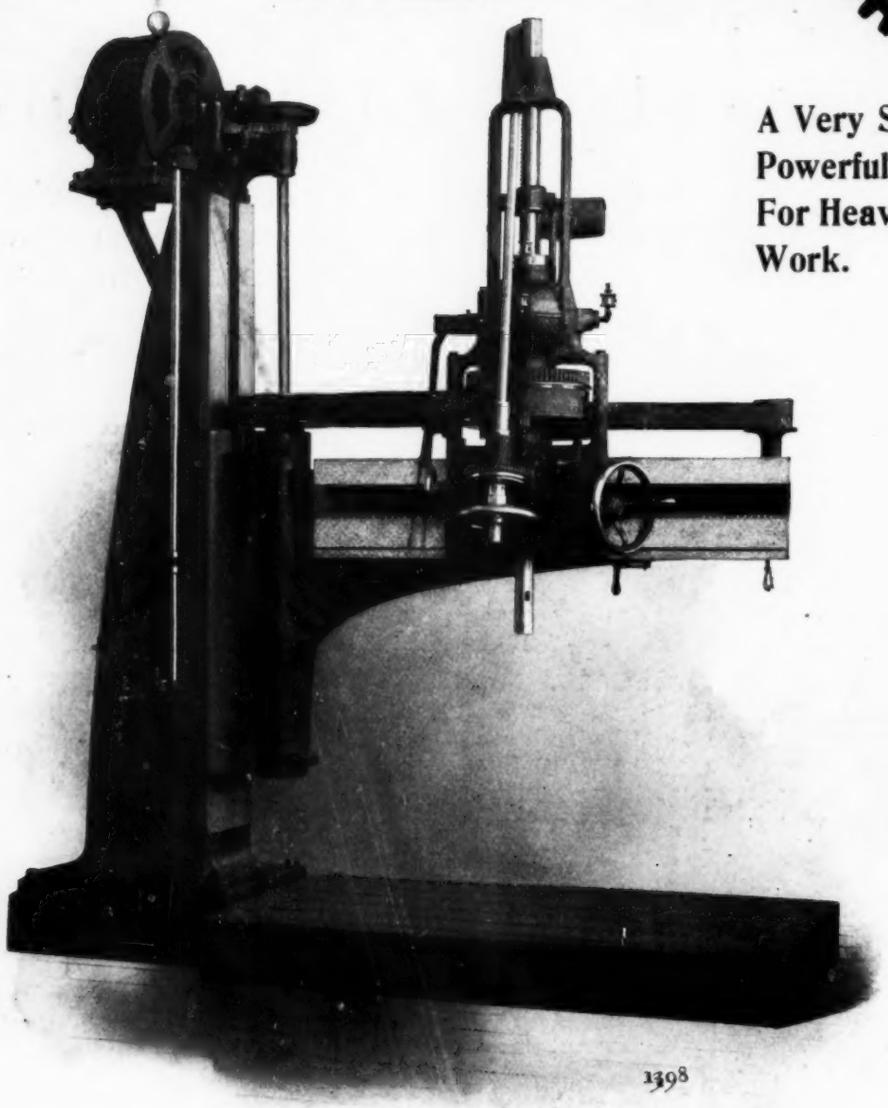

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The traverse of the saddle on the swinging arm, and of the spindle, which is counter-balanced, is by means of rack and pinion so placed that the workman can operate both and swing arm at the same time, enabling him to readily bring the drill to the work.

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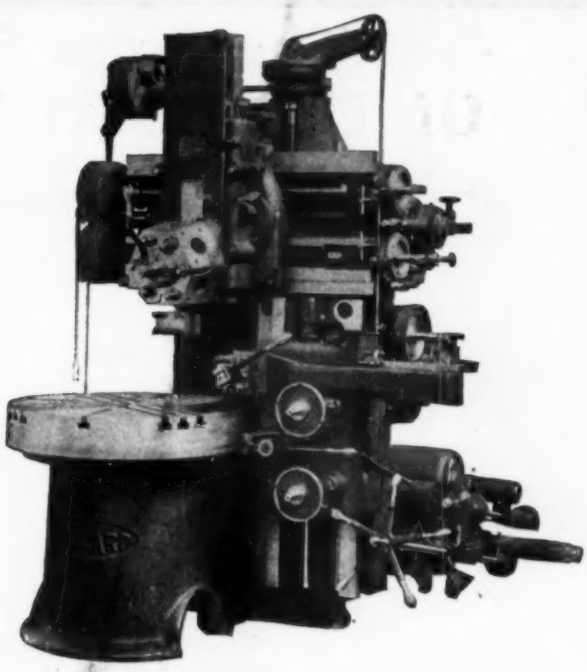

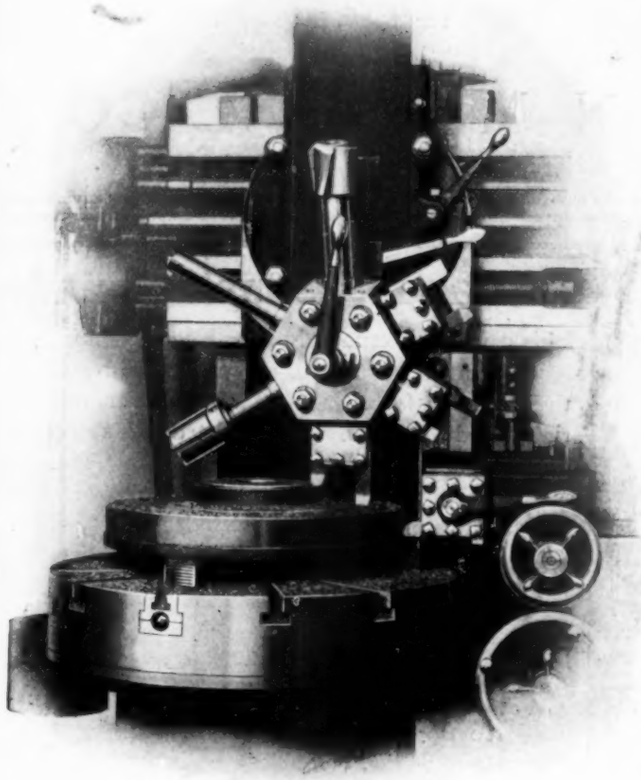

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Machining A Gear Blank

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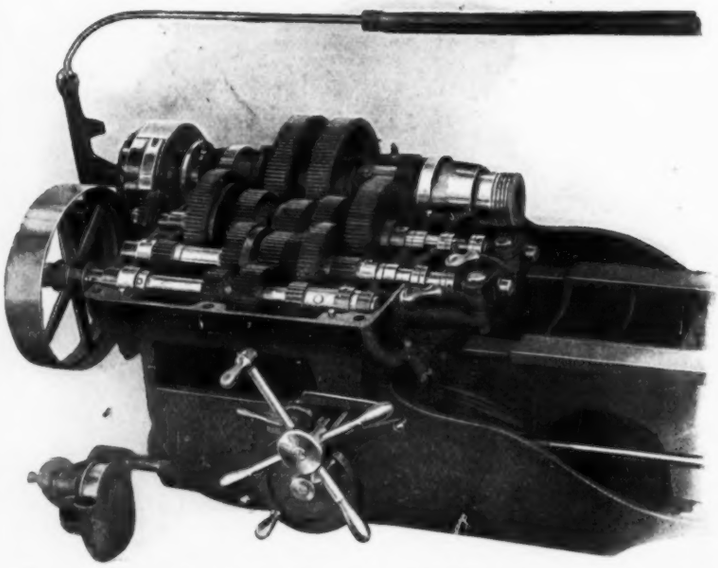
The Cross Sliding Head Of The "Flat Turret" Lathe



which has lower half of all shafting and gearing submerged in oil, provides a cross feed for each tool. It is furnished with ten stops carried in a revolving holder which can be turned at will by the operator.

These stops positively arrest the travel of the head. The cross sliding head is undoubtedly the most efficient speed variator ever devised.

For more "Flat Turret" features see pages 12 and 13 of this issue.

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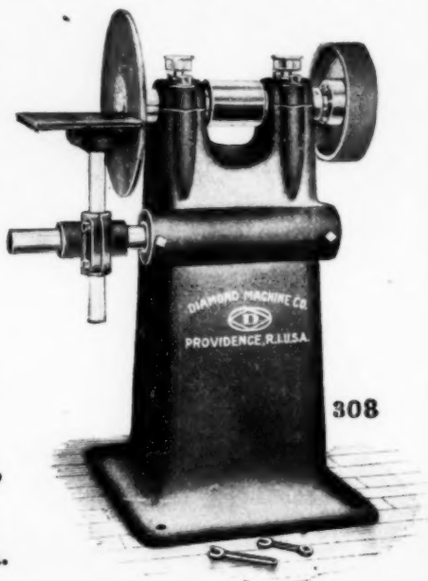


Diamond Machine Company,

Providence, R. I., U. S. A.

The Largest Planer in the World

A Machine Which Weighs Over 420 Tons and Requires More Than 200 Horse-power to Drive It.

EDITORIAL CORRESPONDENCE

Ordinary adjectives seem almost to have lost their meaning when we come upon a tool of this size, and our minds are impressed more by a quiet comparison of sizes as shown in the illustrations than by any words we could use.

A general idea of the machine can be had from Fig. 1; its size begins to impress itself when we compare the hight of the men with the tool heads and clapper boxes on the cross rail. Another good comparison is given in Fig. 9.

The distance between uprights is 14 feet 4 inches; the cross rail can be raised 12 feet 2 inches above the table, and the maximum travel is 30 feet, large enough to handle a block of steel about the size of the largest box-car body in common use. There are many flats in Harlem that would rest very comfortably on the bed of this machine, while so called apartments of two rooms and a bath, which rent for a good many dollars a month, could be carried back and forth on the table and leave plenty of room for bolting down around the outside.

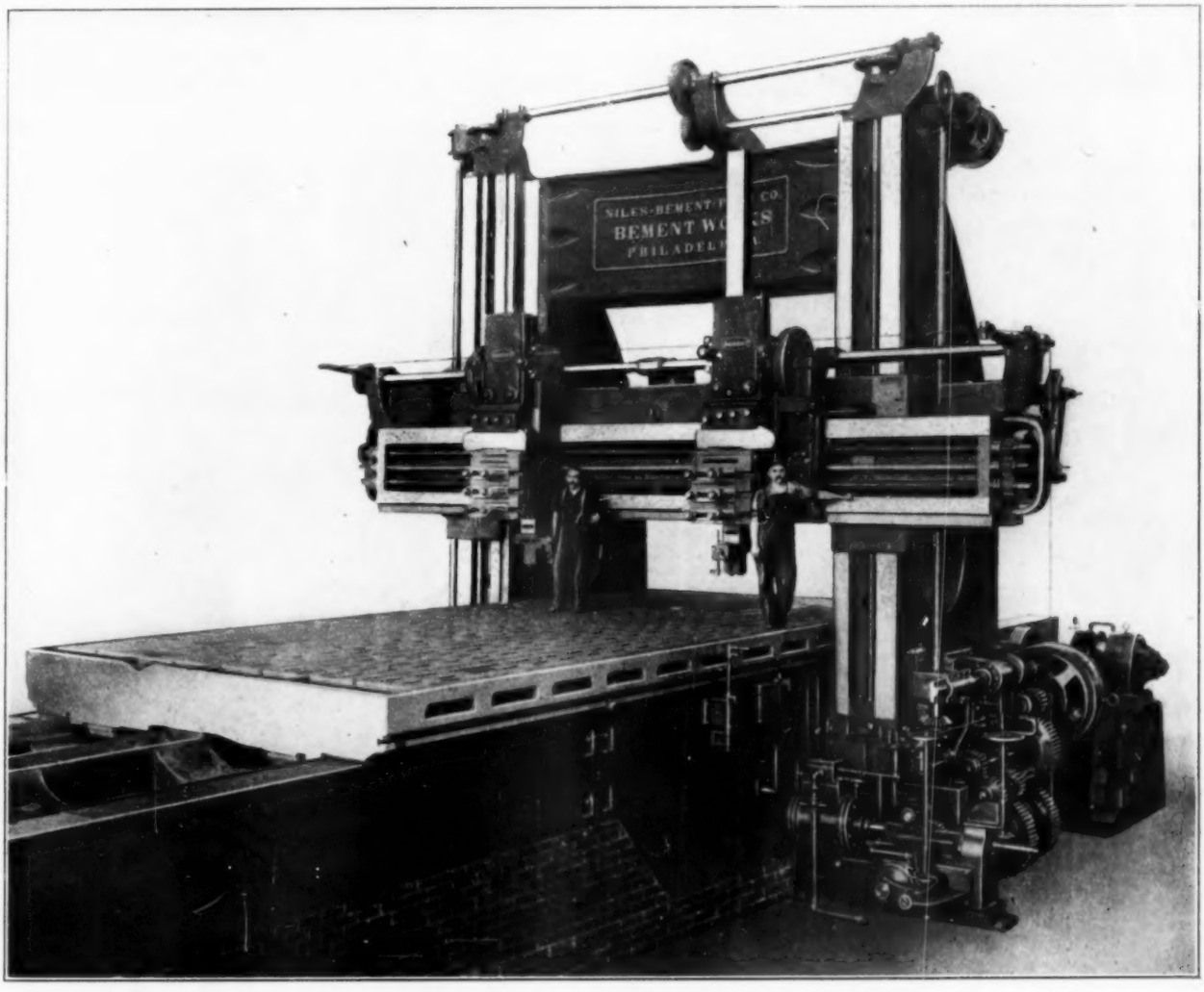


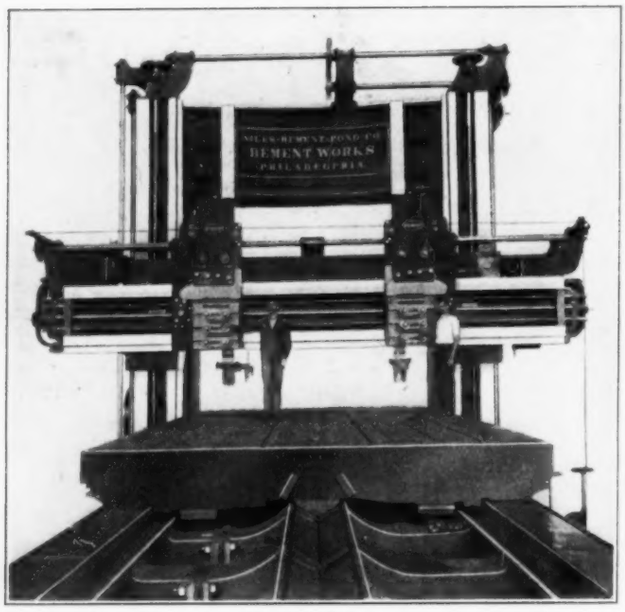
FIG. 1. THE LARGEST PLANER, WITH SLOTTING HEADS, WEIGHING 845,000 POUNDS WHICH COULD CARRY A LARGE BOX-CAR BODY ON THE TABLE

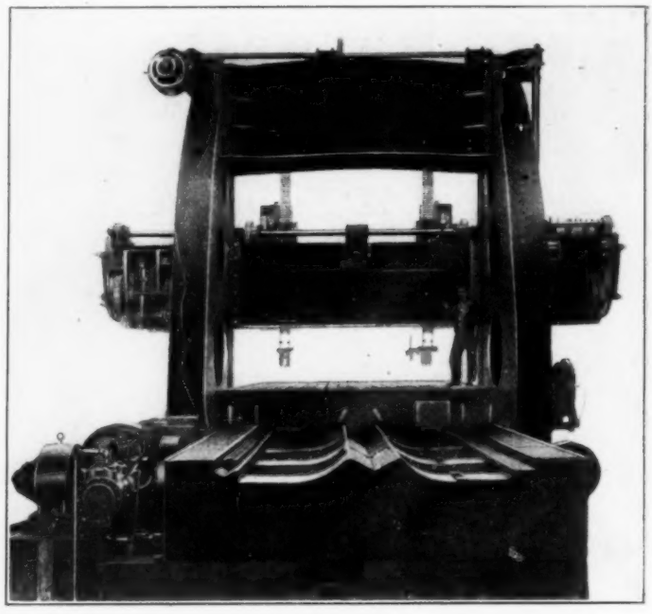
While this is primarily a planer, it has an independent slotting bar in each head; the heads are also arranged for planing across the bed, and the heads have a special power movement along the rail for this purpose.

The total weight of the machine is 845,000 pounds, or 422½ tons, about as much as a modern passenger locomotive and a six-car train, while the fact that the machine has available for its use a total of 207½ horse-power, divided among five electric motors, is a striking illustration of its size. When we think of the machine shops that have over a 200-horse-power engine for the whole plant, we begin to realize something of what concentration of power in machine tools really means.

The air compressor for operating the power drives of both planer table and the feeds, as well as all the other motors, are controlled from the switchboard shown behind the main motor in Fig. 7. Details will be given under the proper subheads.

As no one not having the best of facilities and the largest types of tools could





FIGS. 2 AND 3. FRONT AND REAR VIEW OF THE LARGEST PLANER

undertake the building of such a tool as this, it seems very natural to find that it was made by the Niles-Bement-Pond Company, at the plant of Bement, Miles & Co., in Philadelphia. The planer was built for the Mackintosh, Hemphill Company, of Pittsburg, for machining heavy engine beds, rolling-mill frames, etc., and the first job that came along for it was a bed weighing 94 tons.

The Bed and Uprights

The bed is built up in sections, both on account of shipping and of machining in its manufacture. The way the main part is divided can be seen best in Figs. 15 and 16, there being three parts, the two sides and the center bolted in between and carrying most of the bearings for the driving mechanism. The ends are in two pieces, but not in halves, as the division is at one side of the central V, as can be seen in Figs. 2 and 3, making seven parts to the bed in all.

Fig. 1 gives a general idea of the bed, showing the comparative depth of the main portion and the ends, while in Fig. 12, with the main part upside down, we realize what 73 inches depth of bed really means. Where the ends join the main part of the bed, horizontal keys are provided to assist in the alinement, as shown in Fig. 12; the key itself can be seen in several of the views, projecting slightly from the bed. In addition to this, all the bolts are tapered and drawn into reamed holes.

The total length of the bed is 60 feet, the width 13 feet; it weighs about 275,000

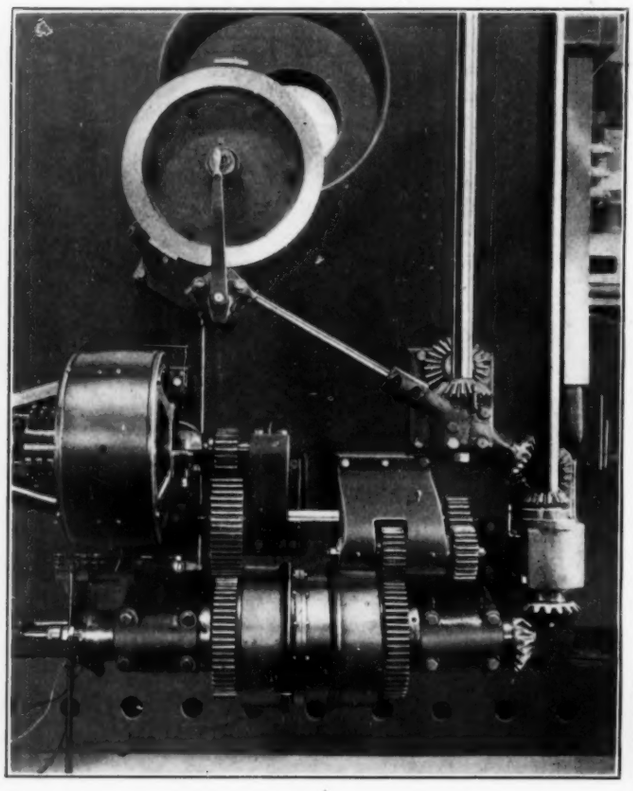


FIG. 4. SLOTTER HEAD AND CROSS PLANING DRIVING GEAR

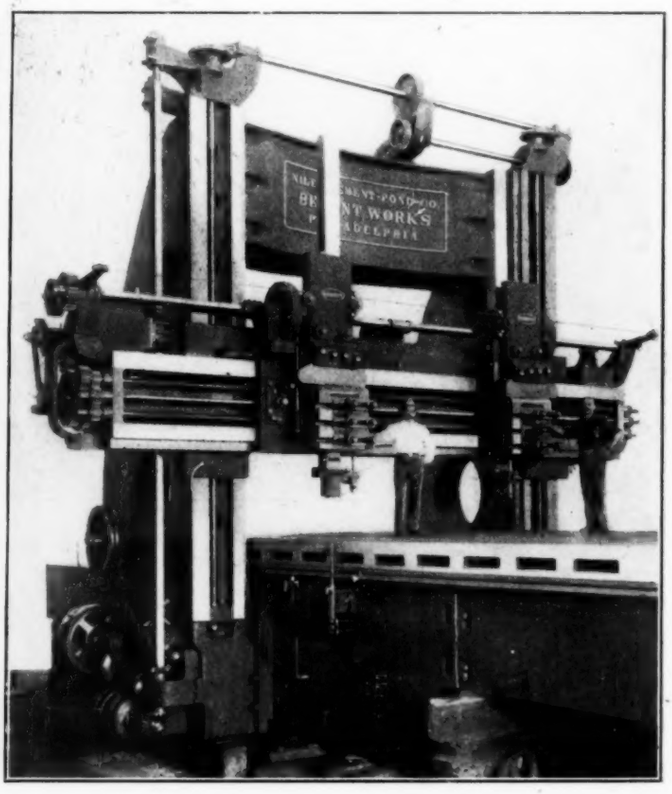


FIG. 5. CONNECTIONS FROM DRIVING GEAR TO SLOTTER HEADS

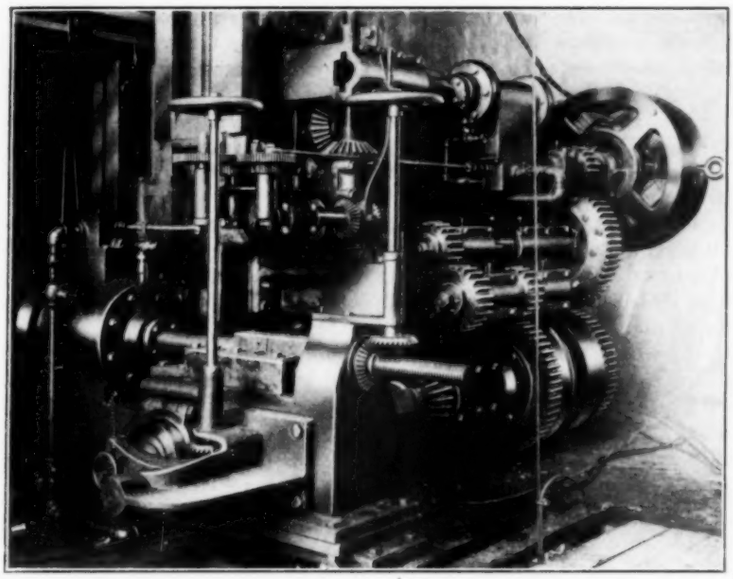


FIG. 6. DETAILS OF THE PNEUMATIC FEEDS

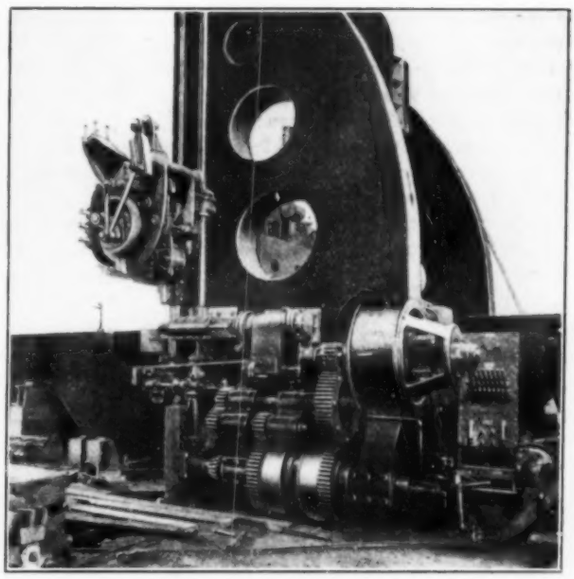


FIG. 7. MAIN DRIVING MOTOR AND CLUTCHES

pounds, or considerably more than the average locomotive of today, which we call heavy, for 137-ton locomotives are not common.

Making the bed in sections adds much to the difficulty of getting the ways and other parts to line up accurately, and requires careful work all along the line. Assembling and testing are also difficult under such conditions; but the men were on their mettle, and everything came together as nicely as anyone could ask.

The uprights or housings are shown separately in Fig. 10, and more nearly assume their correct proportions when compared with the man than when viewed in connection with the rest of the machine. The large bearing surfaces, both for the bed and the cross-tie beam at the top, show the ample proportions for strength and rigidity. The cross tie is practically of the same section as the planed pad for the whole length, being curved to allow the cross rail to pass, as is usual. The lower bearing has substantial tongues which fit corresponding grooves in the side of the bed (see Fig. 12) to insure rigidity and maintain alinement. The face of the uprights, where the cross rail travels, is 30 inches wide.

When these were first assembled, the test indicated that they were only 0.006 inch out of plumb at the top, which can be called pretty nearly right on a 26-foot beam. The openings through the uprights into the bed were all bored from "laid out" holes; but they matched up perfectly, which speaks well for both the laying out and the men who did the boring.

The Table

The table is also in two pieces, joined in the center over the V-slide. The weight is about 140,000 pounds. It is designed with an upper and lower plate having cored openings between, which extend to the edge, as can be seen in several of the views. The holes for stop bolts and similar purposes run entirely through the upper plate, but the lower plate prevents any chips from working down into the gears and on the ways. The side openings allow them to be removed with scrapers.

The table is 14 feet wide, about 32 feet long and 20 inches deep over the side ways. These ways are flat, 15 inches wide and are supplemented by a central way of V shape with an included angle of 120 degrees. The general construction of the

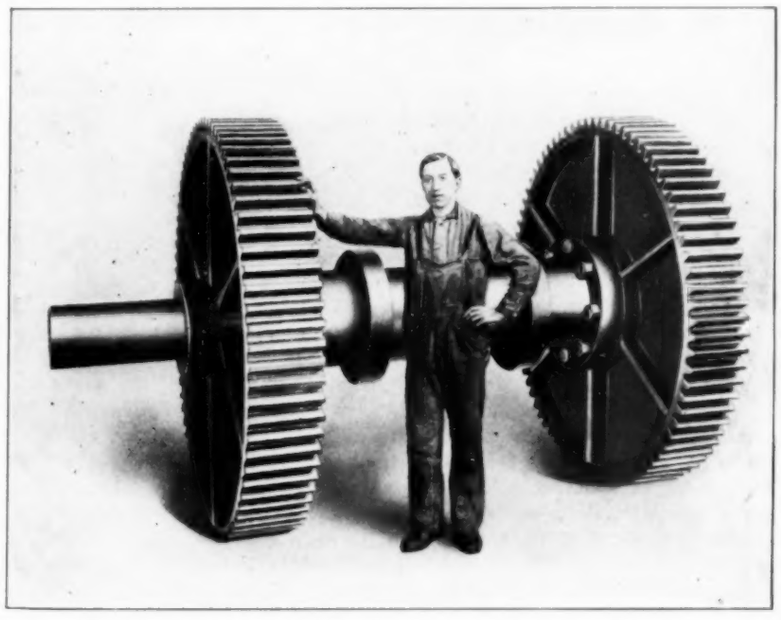


FIG. 8. THE BULL WHEELS—80 INCHES PITCH DIAMETER

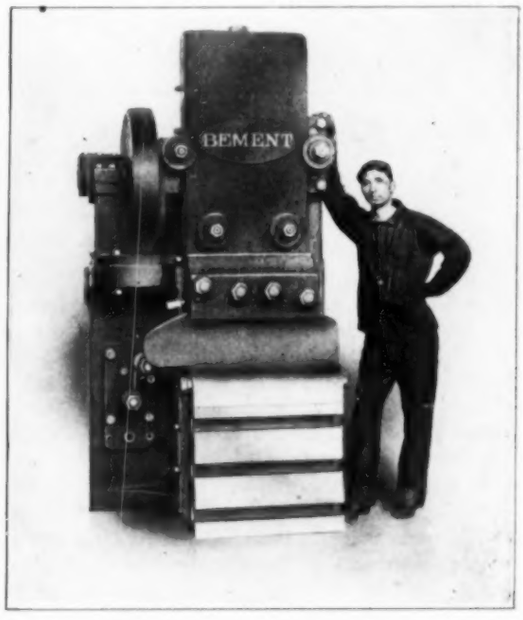


FIG. 9. TOOL HEAD—7 FEET 8 INCHES HIGH

table can be seen in Fig. 20, which shows the two sections, the central V and how it is fitted to the two halves, the stiffening ribs and the two racks, which are 3.14 inches pitch and 15 inches face.

To prevent any possible side movement under a heavy cut, the tool has a projecting rib which extends down inside each of the outer or flat ways. These, in addition to the guiding of the V-way in the center, insure the table running straight with the ways at all times.

Before bolting the table together, the racks were fastened in place and both parts run separately to test the accuracy of the racks and bull wheels. Unless they were both alike, one-half the table would run faster than the other and, if bolted together solidly, one side would do more driving than the other.

To test this a slotted lever was fitted over two studs, one in each half the table, so that any gain on the part of either would be multiplied by the movement of the outer ends of this lever. This test showed almost no variation in the 30-foot travel, or as close as can be obtained by careful machine methods.

Driving the Table

The main drive is the 100-horse-power motor shown in Fig. 1, and in much more detail in Fig. 6. The reducing gears from the motor to the clutches, which are near the floor, give both the forward and the return motion. The forward drive is through the double reduction in the foreground, the reverse by the gears nearest the motor. These speeds are variable through the motor, which has a 1 to 1¼ speed range. Further variations of cutting speed are secured by reversing the small gears at the end, this being easily done by the open or C washers shown. These give a range of cutting speeds from 14 to 25 feet per minute. The return speed remains constant within the changes due to the motor itself, being from 52½ to 62½ feet per minute.

These clutches are of the regular Niles-Bement-Pond design, consisting of a considerable number of friction disks so that a large friction area is obtained in a small space, considering the power handled in this way. They are controlled by compressed air, furnished by an air compressor which is a part of the machine and can be seen very plainly in Fig. 3. Looking from the front, it is hidden behind the main motor and its driving gears.

Hand control of the table movement is obtained by the standards near the tappets at the side of the table on each side of the bed. These control the air valves that operate the clutches both for regular and cross planing.

The driving mechanism is entirely of steel. Starting with the bevel pinion at the front of the clutches and under the adjusting screw in Fig. 6, it goes under the bed, as seen by the rear shaft in Fig. 16. The pulley on this, however, does not belong there, but is only being used in erecting, as a bevel gear on this shaft meshes with the pinion on the clutch shaft. A pinion on this shaft drives the large central gear on the intermediate or bull-pinion shaft; from the size of the bearing shown, together with their support clear up to the gears themselves, both the power handled and the way it is taken care of become apparent.

The bull pinions are both forged on the bull shaft and mesh into the bull wheels, which are connected by a sleeve having a bearing in the center, as shown in Figs. 8 and 16. This central bearing runs in the box formed by the central portion of the bed; in addition there is a shaft running through the sleeve and into the bed on each side. The hole in the bed is seen at the left of Fig. 15 and comes just behind the man's bent arm in Fig. 12.

The shaft is stationary, the sleeve with the bull wheels running both on the shaft and in the box in the center, giving the bull wheels all possible support and yet allowing easy removal by taking off the cap to the bearing and pulling the shaft out through the side of the bed. This is believed to be a new construction.

The bull pinions and consequently the bull wheels are cut a half pitch apart to insure the steadiest possible pull on

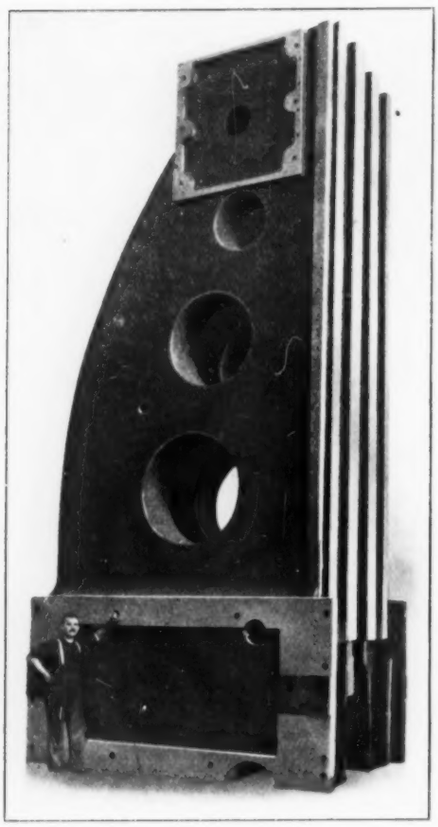


FIG. 10. THE UPRIGHTS WITH PADS FITTING TO BED

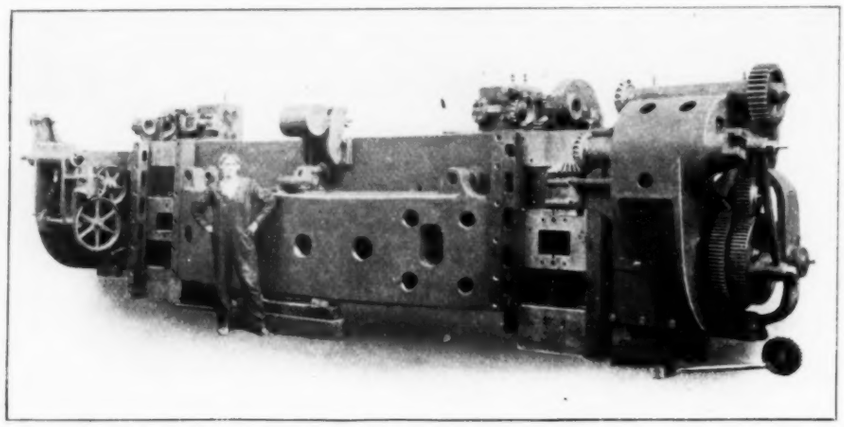


FIG. 11. THE CROSS RAIL BEFORE MOUNTING

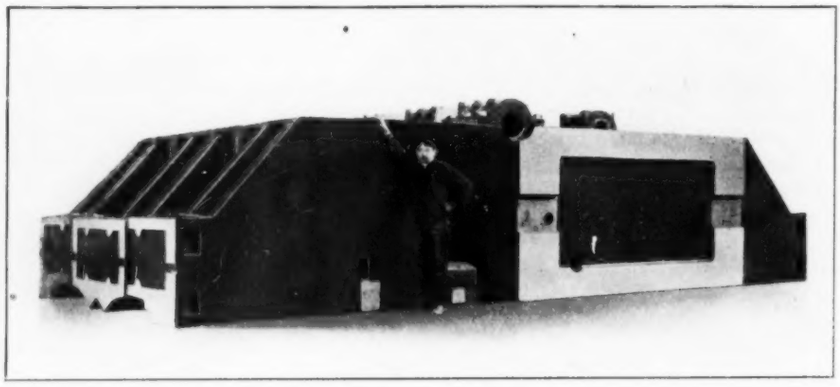


FIG. 12. THE MAIN PART OF BED, UPSIDE DOWN

the table, the rocks being of course set to correspond.

The bull wheels are 15 inches face and are of 1 diametral or 3.14-inch circular pitch, having 80 teeth and being of course 80 inches in diameter on the pitch line or 82 inches outside diameter. This would make the tooth 1.57 inches thick on the pitch line, and the two present 47.1 square inches of steel at the pitch line to drive the table against the tool.

The bull wheels were cut on the regular gear cutter, but the racks were cut on a planer in 56-inch sections, with formed planing tools. Two heads were used and the tools set very carefully to the correct distance apart for as many teeth as decided on. When these were cut, distance pieces were used to show the correct movement for one head; then this was locked and the other head moved a like amount. The use of distance pieces or blocks gave positive stops and was quicker as well as more accurate than measuring the tools themselves in the ordinary way.

The Cross Rail and the Tool Head

The size of the cross rail can be estimated from the man standing beside it in Fig. 11, as well as in the other views. It is long enough to admit the full traverse of the heads and can be raised 12 feet 2 inches above the table.

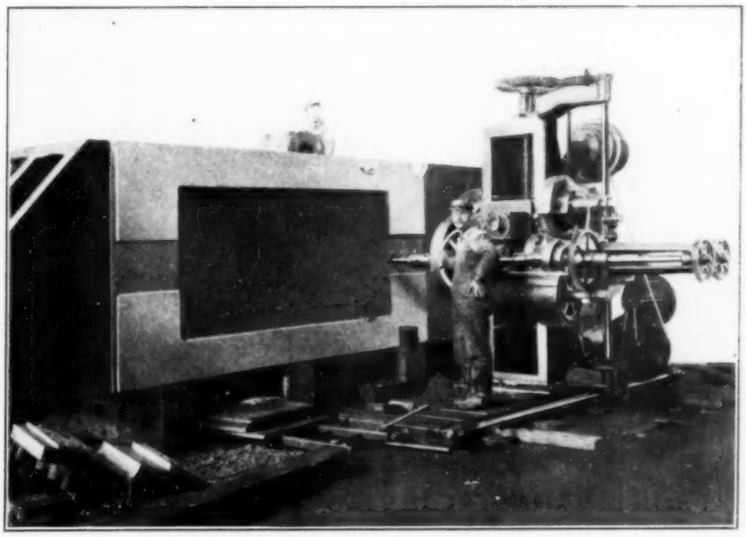
There is a power traverse so that the heads can take a cut across the planer to face the end of a piece of work if desired. This cross-cutting speed ranges from 11½ to 19 feet per minute, with a quick return of from 35 to 43½ feet.

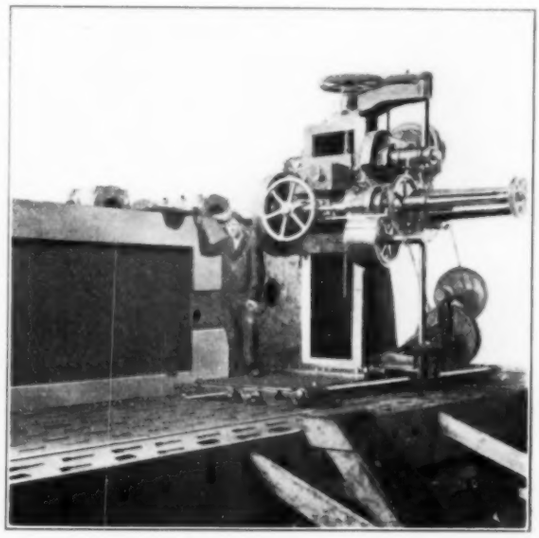
The regular power movement of the heads along the rail is 50 inches per minute, and the cross slide itself travels 26 inches per minute under power feed.

There are two motors for the cross slide, one of 20 horse-power for vertical travel and another of 7½ horse-power to move the tool heads along the cross slide in getting them up to the work.

The small motor is shown at the left end of the cross slide in Figs. 3 and 7, and the larger or hoisting motor at the top of the upright in several views. The tool-traversing motor is connected through friction clutches, and a safety device is provided which prevents throwing in this and the feed mechanism at the same time. The hoisting motor is connected rigidly to the elevating screws and is started, stopped and reversed electrically.

The elevating screws for the cross rail are held firmly at both top and bottom and the nut in the cross rail against a shouldered end in a square pocket. This precaution is to take care of the thrust from





FIGS. 13 AND 14. USING PORTABLE BORING MACHINE ON THE BED

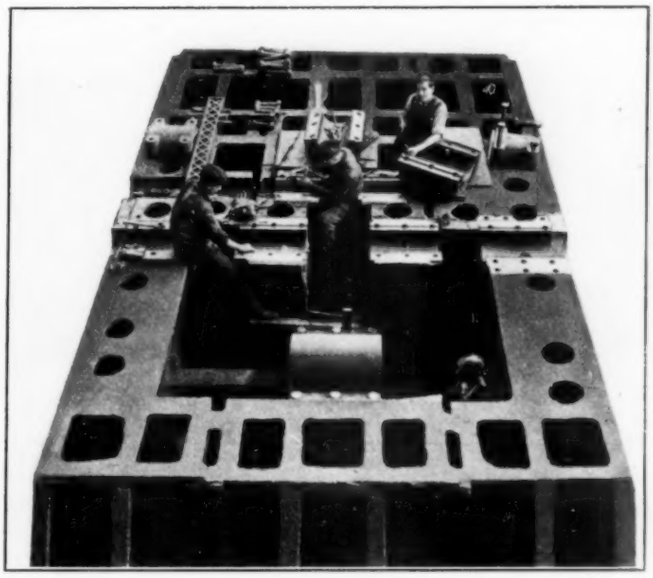


FIG. 15. FITTING THE MAIN BEARINGS

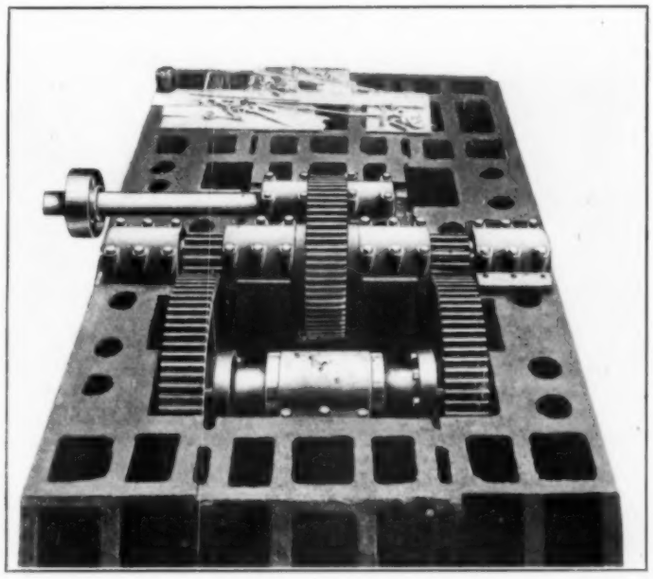


FIG. 16. THE DRIVING GEARS IN PLACE

the slotter bar; but should any loosening or other trouble be experienced, arrangements have been made to brace or clamp the cross rail to the uprights.

Power for the cross planing is obtained from the same 50 horse-power motor that drives the slotting bars. This motor is shown in Figs. 4 and 5. Details of the operation are reserved for the slotting-mechanism description.

Fig. 11 is a back view of the cross rail before mounting on the uprights and shows the arrangement of the feed gearing very plainly; the motor is to be mounted on the farther end.

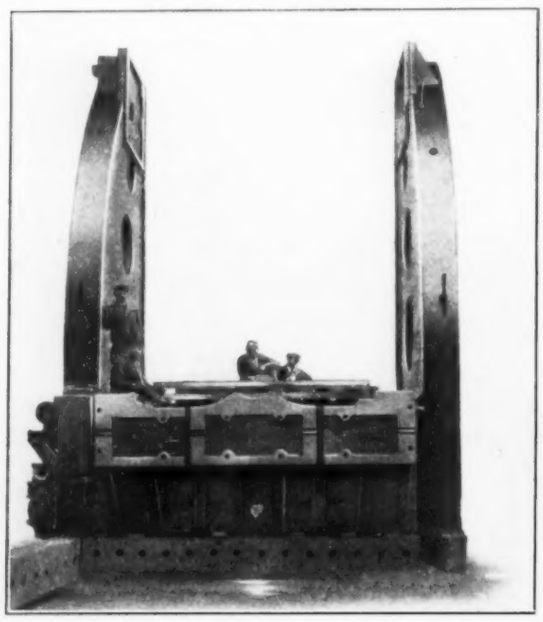
The forked levers at each end, in front of the gear cases, shift the driving pinion on the square shaft (not in place in Fig. 11), to throw the slotter bar in or out of mesh with the large gear shown. This is on a short shaft running to the pinion which drives the slotter bar. At the left of the forked lever is a worm and worm wheel which moves a single-tooth pinion, the tooth being just visible between the bearings and in its lower position. This is for raising and holding the slotter bar in its extreme high position when using the machine as a regular planer.

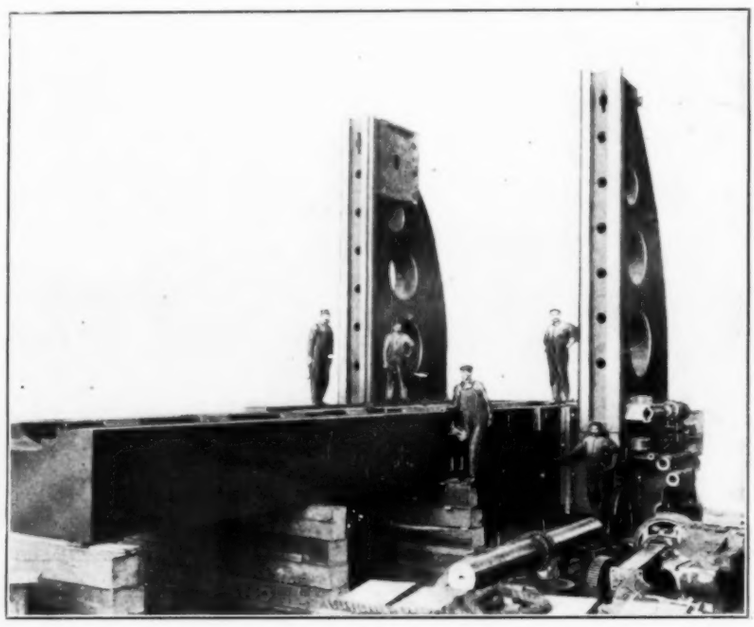
Although some idea of the size of the tool head is obtained from the general views, the whole takes away something from the parts; but in Fig. 9 we have a comparison that is almost startling. The hight is 7 feet 8 inches, and it has a vertical-feed movement of 4 feet. The whole head does not swivel; but the tool block or clapper box can be swung around by the worm at the top, which works in teeth cut in the upper edge of the apron segment. The casing at the top conceals the gearing for the slotter-bar movement. The two hex-bolt heads below this are for adjusting the tool slide by hand, one for vertical movement and the other for moving the tool head horizontally along the rail.

Slotting and Cross Planing

On the opposite side of the machine from the main drive and very similar to it in many respects, is the mechanism for driving the slotter bars and the tool heads for cross planing, as shown in Figs. 4 and 5. The motor on this side is of 50 horse-power, and the gearing and clutches are of the same design as the main drive but of smaller size; but here the similarity ends.

Instead of being carried straight through the upright into the bed as in the main drive, the power in this case is transmitted through the bevel gears to the square vertical shaft at the right. This in turn transmits the power through bevel and spur gearing to the horizontal square shaft running along the top of the cross rail, as seen in Fig. 4 and other views. This shaft carries a pinion for each slotter bar, which drives a large gear inclosed in the casing over the tool heads; there is a pinion on the same shaft with this which gears into and drives the rack on the back of the slotter bar. The pinions on the square shaft slide and can be thrown out of gear so that both slotting bars can be used at the same time, or they can be used independently if desired.





FIGS. 17 AND 18. ERECTING THE BED AND UPRIGHTS

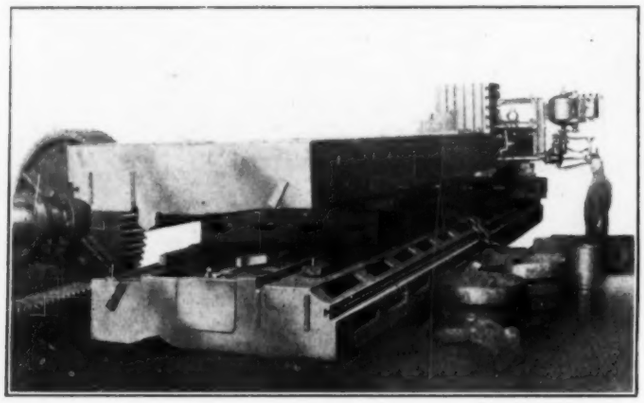


FIG. 19. USING PORTABLE DRILL ON ANGLE BLOCK

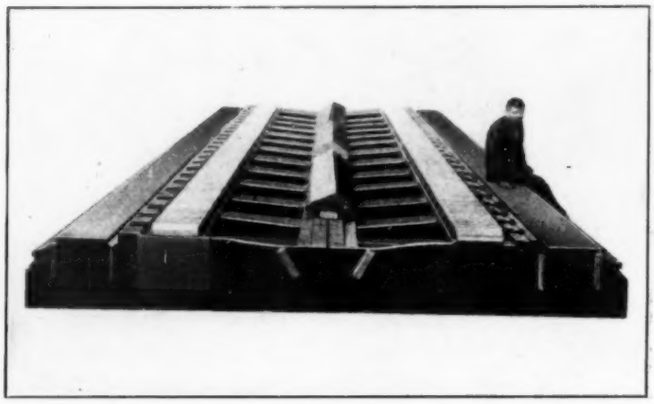


FIG. 20. TABLE WITH RACKS AND SLIDES

The maximum stroke of the slotter bar is 8 feet, and the length of stroke is controlled by the disk shown at the top of Fig. 5, just above the motor. This disk carries a worm wheel, shown in Fig. 4 but not in Fig. 5, and is driven by the three bevels just over the main bevel gears which drive the vertical square shaft. This disk has on its rim two adjustable stops which can be set at any desired point and which reverse the air pressure on the clutches by throwing the valve to the right or left through the mechanism shown. The hand bar enables the stroke to be reversed or controlled by hand. The bevel gears shown at the bottom of the round vertical shaft transmit the feed to the tool heads from the other side of the bed, as previously mentioned.

The slotting tool is held in a head which has a cross movement by hand with a ratchet as shown, so that the tool can be adjusted to the work without moving the whole tool head.

When cross planing, the tool head strikes the roller in the center of the cross rail (see Fig. 2) and forces this to raise the weight and lower the tumbler bearing of the square shaft by the connections shown at the back of the cross rail in Fig. 11. This keeps the square shaft supported at all times and yet does not prevent passage of the heads.

The Pneumatic Control and Feed

A 30 horse-power motor is used to drive the air compressor which supplies compressed air for both the clutches and the pneumatic feed, this latter being one of the novelties in this design. This seems like a large air compressor for this work, but on short work the clutches and feed operate very frequently and require considerable air.

The starting, stopping and reversing of the table are under the control of a small valve easily moved by hand and shown under the right tool head in Fig. 1, below the table. This is connected with the hand lever at the left so that it can be operated either by hand when the handle is in the lower socket or by the tappets in the usual way. This valve admits air to either the forward or backing clutch as the case may be, and in this way handles the 100 horse-power very satisfactorily, making an all-gear drive with everything positive except the clutches. Beyond these the drive is the same as any planer, except that it is very heavy.

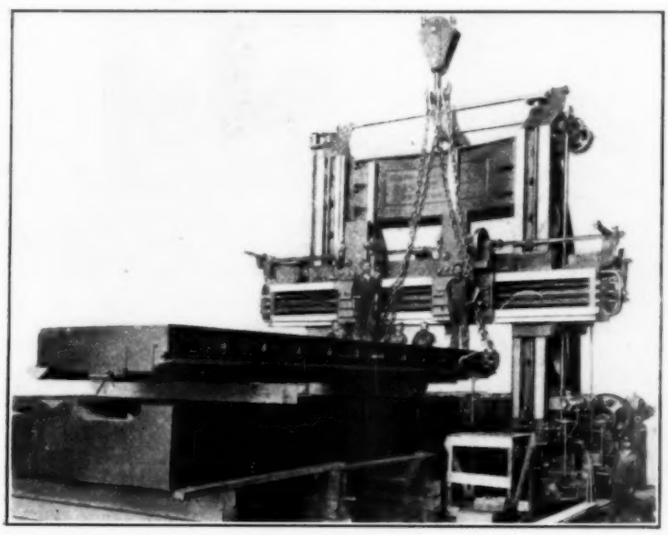
The pneumatic feed for the tool heads is obtained from the horizontal cylinder shown in Figs. 6 and 7 above the gearing. The piston rod to the left carries a rack which meshes with a gear on the vertical-feed shaft just above the bevel gears which transmit the feed through the bed to the other side. The feed movement is constant at all times, but it can be cut out by closing a valve which cuts off the air supply.

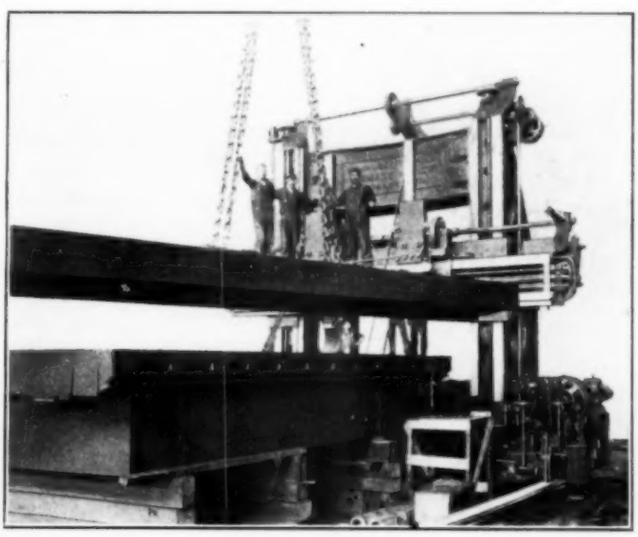
The valve controlling the admission of air to the feed cylinder is reversed automatically at the end of the stroke by a connection with the main driving-gear train to the table when planing is being done or from the slotter gearing when the slotting heads are in use.

Variations of feed are obtained by adjusting the connecting rods in the slotted cranks at the end of the cross rail, these being graduated for definite feeds. The whole heads do not swivel, but an angular feed is obtained by using the cross and vertical feeds of the tool heads at the same time in such proportions as will give the desired angle. For this purpose the graduations on the slotted cranks are of great assistance.

When being used as a slotter or when the heads are used to plane crosswise of the table, the work must be fed to the tool by moving the table itself toward the tool. This feed is also pneumatic and can be seen in detail in the foreground of Fig. 6. The valve of this cylinder is driven from the same gear train as the other, but it differs from it in having a stop for regulating the travel of the piston. The hand wheel at the right, through the bevel gears moves the screw to any desired place, carrying the right-hand block with it. This block forms a positive stop for the left-hand block and so limits its travel. This block operates through a pawl, shown on top of the wheel in Fig. 1 and at the side in Fig. 6, which works in the gear just visible behind the housing. Regulating the travel of the piston determines the number of teeth the pawl picks up at each movement, determining the feed in the usual way. The other hand wheel connects or throws out this feed mechanism from the main driving works when regular planing is being done.

The air compressor pumps into a receiver which can be seen, with its pressure gage, under the switchboard in Fig. 7.





FIGS. 21 AND 22. HANDLING SECTIONS OF THE TABLE

The standards for controlling the table movement by hand, as before mentioned and as shown on both sides of the planer, also allow hand control of the slotter-bar travel from either side of the bed as well as from the reversing disk. The controlling stand has two sockets, the upper one being connected to a shaft running down through the other and connecting by the curved rod shown in Fig. 4 with the hand lever at the reversing disk, by the shaft running through the upright. Only one handle is provided for each side of the planer, so that errors are not likely to be made in moving the wrong lever.

The change of drive from slotting to cross planing or the reverse is through the bevel gears on the square shaft just above the cross rail at the left of Fig. 4. The upper bevels drive the slotter bars through the spur gears shown, while the lower pair, through the train of spur gears shown, drive the heads along the rail for cross planing.

PROVISIONS FOR TRUING THE WAYS AND TABLE

One of the most striking novelties in the design of this machine is the provision for truing the ways in both bed and table when they wear enough to make it necessary or desirable. This is an unusual provision, but it is also an unusual machine, and must be made self contained in every way. In all the views showing the end of the table will be seen finished strips or pads over all three of the ways, both the flats and the V's. These are to carry the tool heads for truing up the ways.

It will also be seen that inside the main flat ways are a pair of auxiliary ways, one V, the other flat. They are the truing ways, which have been finished with a high degree of accuracy, as on them depends the alinement of the main ways after being trued. They are not used except for this purpose.

In order to use this device, the table is raised a slight amount, ¼ inch, or as much as may be necessary, and supported in this position on sliding blocks which fit the auxiliary or truing ways. The truing heads are fastened to the table and the ways trued up from pockets in the center of bed. Then the heads are transferred to the other end of the table and the other half of the ways finished. The truing heads are taken off the table and placed in the center pockets with the tool inverted, and with this in position the table is run back and forth until the table ways are planed.

The building of such a machine as this involves many difficulties as, on account of the size of the pieces, they have to be machined by portable tools and many improvised devices brought into use. Then, too, the erection is more costly in every way, as the parts must be handled differently and it is much harder to secure perfect alinement of parts, as in the case of the bed and the table. Planing the bed in sections and having them line up accurately enough to be scraped to a bearing requires the best of work; every step must be tested to be sure that the finished machine is right.

Some of the machining operations are shown in Figs. 12, 13 and 19, and these also show the advantages of portable boring machines for any large work of this kind. In Fig. 13 half the table is being used as a floor plate for the boring machine while the bearings are being bored. Fig. 19 shows a rather unusual application of a portable drill in drilling the bolt holes in the side of the table for the bolts that bind the halves together.

The assembling is shown in Figs. 15, 16, 17, 18, 21 and 22. These views give some of the steps in the process of erection and require more study than description to show the difficulties of handling such heavy pieces the number of times that must be done to fit them together properly. Half a planer table does not seem very much to handle with a crane, and yet it weighs 35 tons or nearly twice as much as a steel coal car that carries 50 tons. F. H. C.

Balancing for High Speeds

BY WM. E. SNOW

With the advent of the steam turbine and the high-speed electric generator has arisen the necessity of more accurate balance of the rotating parts than is necessary in reciprocating sets. The flywheel of a reciprocating engine may be balanced with sufficient accuracy upon a pair of ordinary "parallels," as the two carefully leveled steel surfaces are called, and will run very smoothly at ordinary speeds. A turbine bucket wheel balanced in the same manner and weighing but one-tenth as much would vibrate so badly at high speed as to be detrimental to operation and even a serious menace to safety. The reason for this is apparent from a study of Fig. 1.

The bucket wheel B is supported by the shaft S upon the parallels P P, which consist of steel edges carefully ground and leveled. In this position the wheel will slowly rotate, coming to rest when the heaviest point H is lowest. Weights of various sizes are now tried upon the wheel at the point W, which is the light side and directly opposite the point H. When a weight has been found that just offsets the surplus at H, it is either bolted on at W or a corresponding amount of metal is removed at H, and the wheel is said to be in balance. This would be true if the wheel had no thickness, but this, of course, is not the case.

If the heavy spot H happens to be so located that the center of gravity of its mass lies in the axis of rotation N M of the wheel, as in Fig. 2, then the wheel is still in perfect balance regardless of its thickness. This is rarely, if ever, the case. Ordinarily the center of gravity of the mass H will not be coincident with the axis of rotation of the wheel, varying according to its thickness, as in Fig. 3. In this case the heavy spot H lies considerably to one side of the axis of rotation and the wheel will not be in true running balance, though it may be statically balanced, as in Fig. 1.

Such a wheel, no matter how narrow, will shake badly at a high speed, while in a wide wheel the vibrations become exceedingly violent. In the long armatures of high-speed generators this variation of the centers of gravity of the masses from the axis of rotation is found in its most aggravated form. The elimination of this trouble demands some form of balancing other than the static, and I have adopted the following method with satisfactory results.

FIG. 4. SUSPENSION BAR FOR RUNNING BALANCE

A piece of high-grade tool steel A, in Fig. 4, 6 inches long, and 2 inches wide by ⅜ inch thick, is ground down at the center C to an even thickness of 0.005 inch. This gives a cross-sectional area at C of 0.01 square inch. Assuming the tensile strength of the steel to be only 60,000 pounds per square inch, this will safely support a dead load of 600 pounds. As the wheels to be balanced weigh less than 300 pounds each, this flexible piece of steel is amply sufficient for their support and is far less delicate than it looks. One end of this steel piece A is inserted in a shank D, as in Fig. 5, and is secured in place by a pin. The shank D is then placed in a radial drill or any other suitable and convenient support. From the other end of the steel piece A is suspended

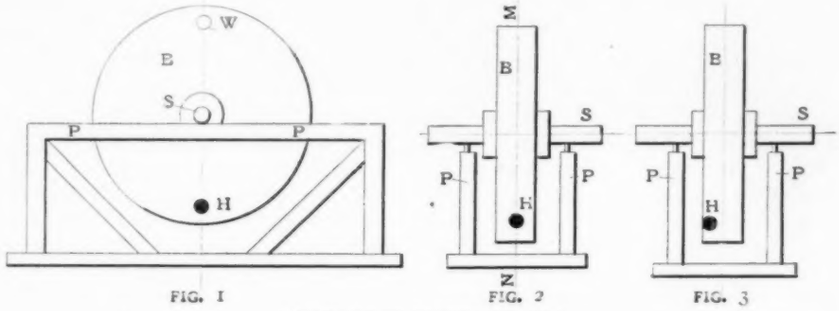


FIG. 1 FIG. 2 FIG. 3

DIAGRAMS OF STATIC BALANCE

a stem E, also held in place by a pin. This stem E is provided with a long pointer or index F extending some 2 feet or more below it. The wheel to be balanced is placed on the stem E, which just fits the bore of the hub, and is secured in position by the collar K. Fig. 6 shows the wheel in position ready for balancing.

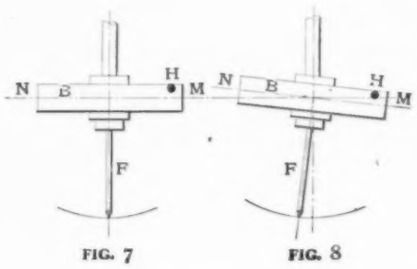


FIG. 7 FIG. 8

DIAGRAMS OF RUNNING BALANCE

In this case we will assume that the heavy spot H will be at one side of the center of the wheel, so that the center of gravity of its mass lies at an appreciable distance from the axis of rotation $N M$, as in Fig. 7. The wheel will now seek a position of equilibrium, as in Fig. 8, the index F indicating the position and magnitude of the mass H. Metal is now removed from the wheel at the point H until, by trial, the axis of rotation $N M$ is brought to the horizontal, which condition will be satisfied when the index F stands exactly perpendicular. The relation of the wheel to the flexible steel support is now changed by giving it an eighth or a quarter turn, so as to bring another portion of its circumference under the influence of the balance.

The remaining portions of the wheel's circumference are all carefully tested in the same way; if, as is often the case, more than one heavy spot is found, each is carefully corrected by the removal of metal. When the wheel can be set in any position throughout the entire 360 degrees without appreciable deflection of the pointer F, it will be in perfect running balance. It will also be found, if placed upon the parallels, to be in perfect static balance.

Although steel forgings are commonly supposed to be of a much more even density than castings and therefore are more easily balanced, this is not always the case. Irregular hammering and the presence of large quantities of scrap—always a variable factor—frequently produce very uneven forgings. The bucket wheel in Fig. 9 is a good example of this fact. Nearly two pounds of metal were removed at the holes X to bring this wheel to a balance. The equivalent of this metal is seen in the weights V below the wheel. The holes R are for construction purposes and being equally spaced have no effect upon the balance of the wheel.

In view of this great irregularity even in forgings, and especially when one remembers that an unbalanced weight of only one-quarter of a pound, on the rim of a 30-inch diameter turbine bucket wheel having a peripheral velocity of 1378 feet per second, causes a centrifugal force in the disk of some 11,000 pounds, the necessity for an extremely accurate

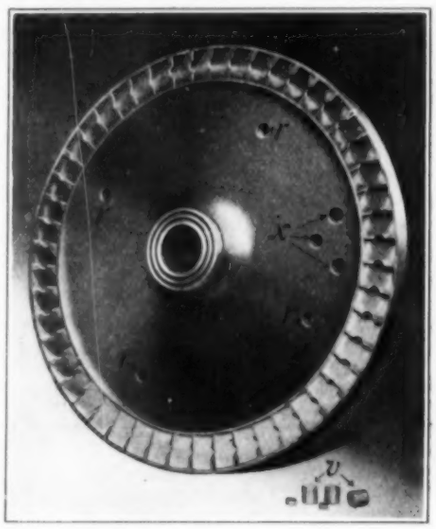


FIG. 9. A STEEL TURBINE DISK SHOWING METAL REMOVED TO PRODUCE RUNNING BALANCE

running balance of the rotating parts of all high-speed apparatus is apparent.

In ten years the South increased the number of its cotton spindles by 6,007,000; it produced in that period over 103,000,000 bales of cotton, and in 1906 its mills used about 2,375,000 bales of American cotton.

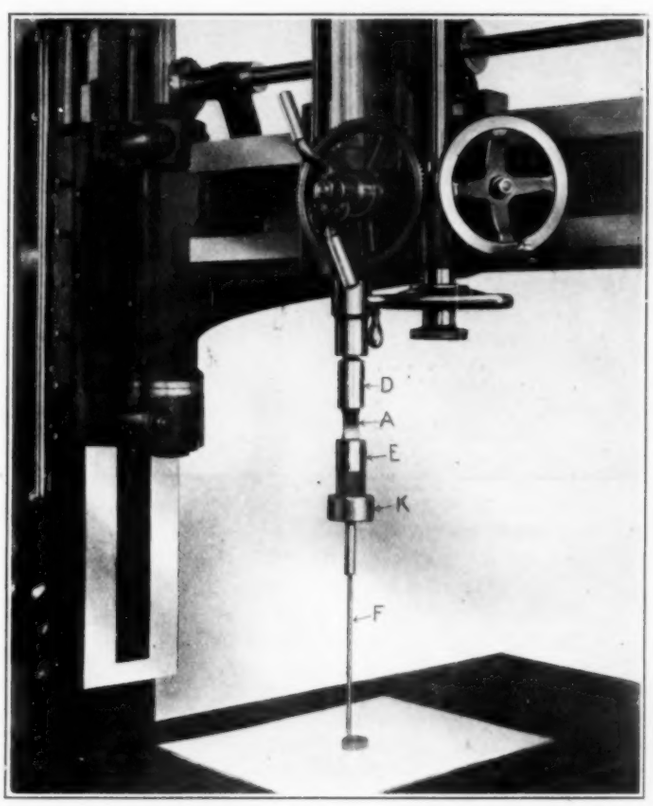


FIG. 5. SUSPENSION BAR, HOLDER AND POINTER INSTALLED IN A RADIAL DRILL

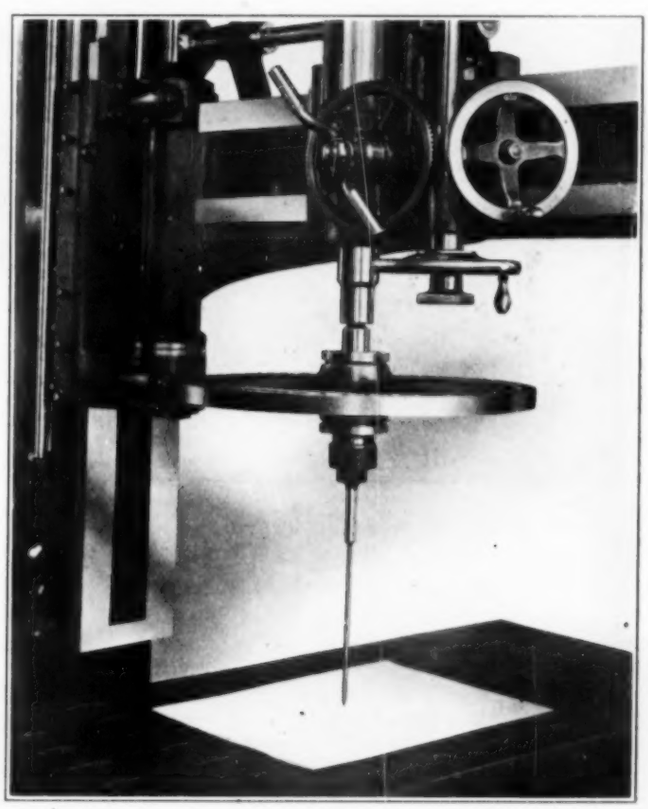


FIG. 6. A TURBINE DISK READY FOR THE RUNNING BALANCE

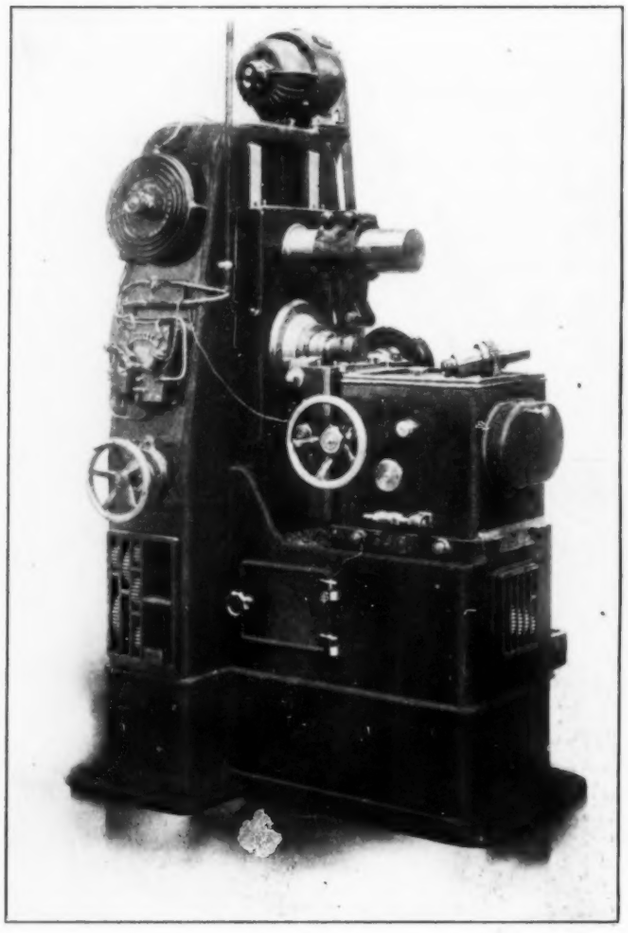
A Hobbing Machine and Dividing-head Tests

How Accurate Worm Wheels for Dividing Heads Are Hobbed in a Special Machine and the Heads Afterward Tested

SPECIAL CORRESPONDENCE

We illustrate as the first feature of this article a special worm-hobbing machine recently built by the Cincinnati Milling Machine Company, Cincinnati, Ohio, for making the worm wheels used in its dividing heads. As will be seen from the half-tones Figs. 1 and 2 and the line drawings Figs. 3 and 4, showing various general views, this machine is of interesting construction; while naturally an expensive special machine to build for accomplishing one operation, its builders feel that the expense was warranted in that it enables them to make better worm wheels than by their former methods. The accuracy used to range from wheels which would index with a maximum cumulative error of say 0.0015 on an 8-inch circle to worm wheels on which the error was too small to be detected. With this new machine an average accuracy is attained which is much better. Of a large number of test sheets recently examined the record on all of them runs either 0.00025 or 0.0005 error in indexing.

The worms and worm wheels are lapped in place at the time the heads are assembled. The object of this is to smooth up whatever slight unevenness may have been left on the worm teeth by the hob. For this lapping process each bench is provided with a small motor and by placing a small grooved pulley on the indexing shaft of the head at the place where the indexing crank belongs, this lapping-in process can proceed while the assembler is busy at work on other parts of the head.



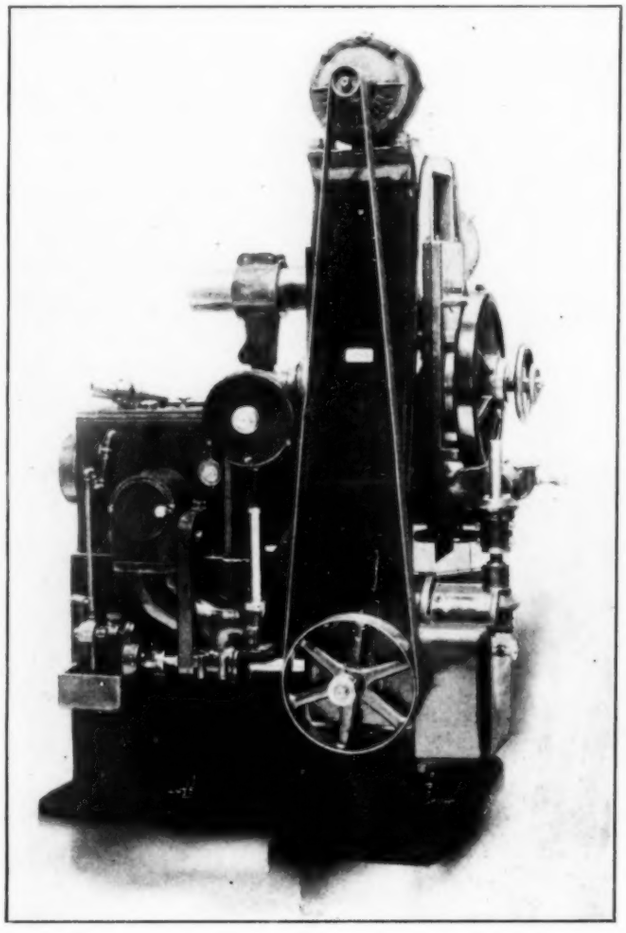


FIG. 1 FRONT AND REAR VIEW OF WORM-WHEEL HOBBING MACHINE FIG. 2

The Hobbing-machine Operation

Referring to the drawings showing the hobbing machine, Fig. 5 shows a vertical section through the hob spindle; Fig. 6 a section through the worm case at the rear of the machine for driving the main worm wheel, as seen also in the other drawings and half-tones. Fig. 7 shows sections of the feed arrangement. The hob spindle is mounted on a slide and is fed vertically into the work. This is accomplished by means of the cam shown on the drawing, Fig. 7, which is driven through the train of feed gears clearly represented in the other drawings.

Assume that a cut is just starting: A slide carrying the hob rests on that part

of the cam which is marked *A* in Fig. 7. Then as the cam revolves from left to right it feeds the hob up into the work gradually until a point at about *B* on the cam face has been reached. From this point around to *C* the periphery of the cam is a true arc of a circle with its center at *D*. Clearly, then, *B* indicates the end of the vertical stroke. While the cam travels from *B* to *C*, the hob simply rotates in the work and has a chance to ease itself in its own cut by removing what little metal may be left on account of spring in the parts; while doing this, it also smooths the cut. This distance *BC* is about one-eighth of the circumference of the circle and it is during this interval that the machine is automatically stopped electrically.

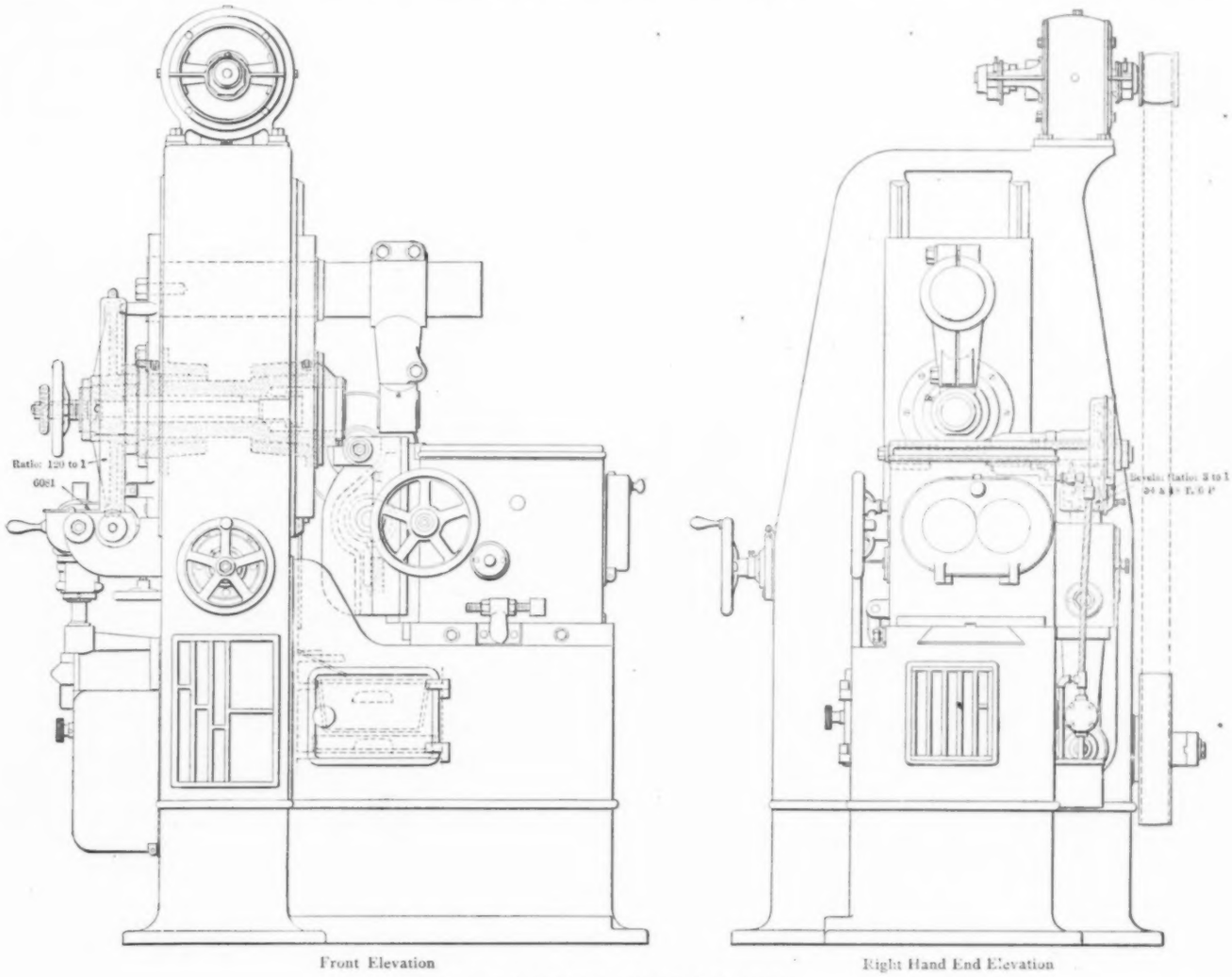
The drawing shows that hand wheel *E* is geared to the cam shaft in an even ratio. This hand wheel is shown in Fig. 1 at the side of the machine near the slide. It carries an arm which, when it nears the end of one revolution, comes in contact with the lever (which can be seen between the arms of the wheel), and the movement of this lever short circuits the current through the small magnet on the starting box, releases the starting lever and the motor comes to a stop.

Dividing-head Tests

In connection with the foregoing description of this special machine for hobbing dividing-head worm gears, the following particulars of some of the Cincinnati Milling Machine Company's methods of testing these heads should prove of interest.

Fig. 8 is an exact reproduction of a test sheet of a 10-inch dividing head inspected September 18, 1907. This sheet was drawn at random from a lot of fifty. The inspection is made as nearly as practicable in the order in which the different items are listed on this sheet.

First of all, attention is given to the different parts of the mechanism, each of which must come up to the required standard before the workman passes the head on to the inspector. At first glance it might appear that these items need not be on the test sheets, since any good workman would naturally give these details his attention when assembling the head. However, experience has proved that it is best not to leave this to the workman's memory; by detailing each item on the test sheet he is reminded of the standard of excellence required and the test to be made on each of these parts. It is evident that the accuracy tests cannot be made until all of the mechanism has passed inspection. On all the accuracy tests the American Watch Tool Company's test indicators are used. These are graduated to read to thousandths of an inch, and the graduations are so far apart that it is easy for an experienced workman to estimate halves and quarters of a thousandth.



Front Elevation — Right Hand End Elevation

FIG. 3. WORM-WHEEL HOBBING MACHINE

Testing the Taper Hole

The first test is made to prove the truth of the taper hole in the front end of the spindle. This is shown in Fig. 9. A hollow test bar, accurately ground and previously proved for accuracy, is inserted in the taper hole of the spindle. The indicator point rests on the outer end of this bar at a distance of 18 inches from the nose of the spindle. When this bar is revolved by the indexing mechanism, the error may be read direct from the indicator dial. The maximum error allowed is 0.0015 inch. In the present instance

the head showed an error of 0.001 inch, that is to say, 0.0005 on each side of the true position.

The second test determines the truth of the front of the taper hole by resting the indicator point against the side of the hole; the reading is taken in the same manner as before. The maximum error allowed on this test is 0.00025, and in the present case the head tested within this limit.

Spindle Tests

The third test determines the alinement of the spindle with relation to the T-slot in the table, the test being made through a length of 18 inches. This is shown in Fig. 10. In this case the test bar is first revolved through the indexing mechanism and the "high point" is determined. The bar is then revolved so as to bring this point 90 degrees from the indicator point. In the illustration this would mean that the "high point" would be at the top or bottom of the bar. Obviously then, the two sides of the bar are parallel with the axis of the spindle. By taking indicator readings along one side of the bar its parallel relation with the T-slot is at once determined. In the present instance it was out of line 0.001 inch in 18 inches. The maximum error allowed is also 0.001 inch.

This is followed by a test to determine whether the center of the spindle is in the same vertical plane with the center of the T-slot. It is a repetition of the preceding test, except that in this case readings are taken at several points along both sides of the bar and noted; the difference between the readings taken at opposite points determines the error. In the present instance there was an error of 0.001 inch in 18 inches, while a maximum of 0.002 is allowed.

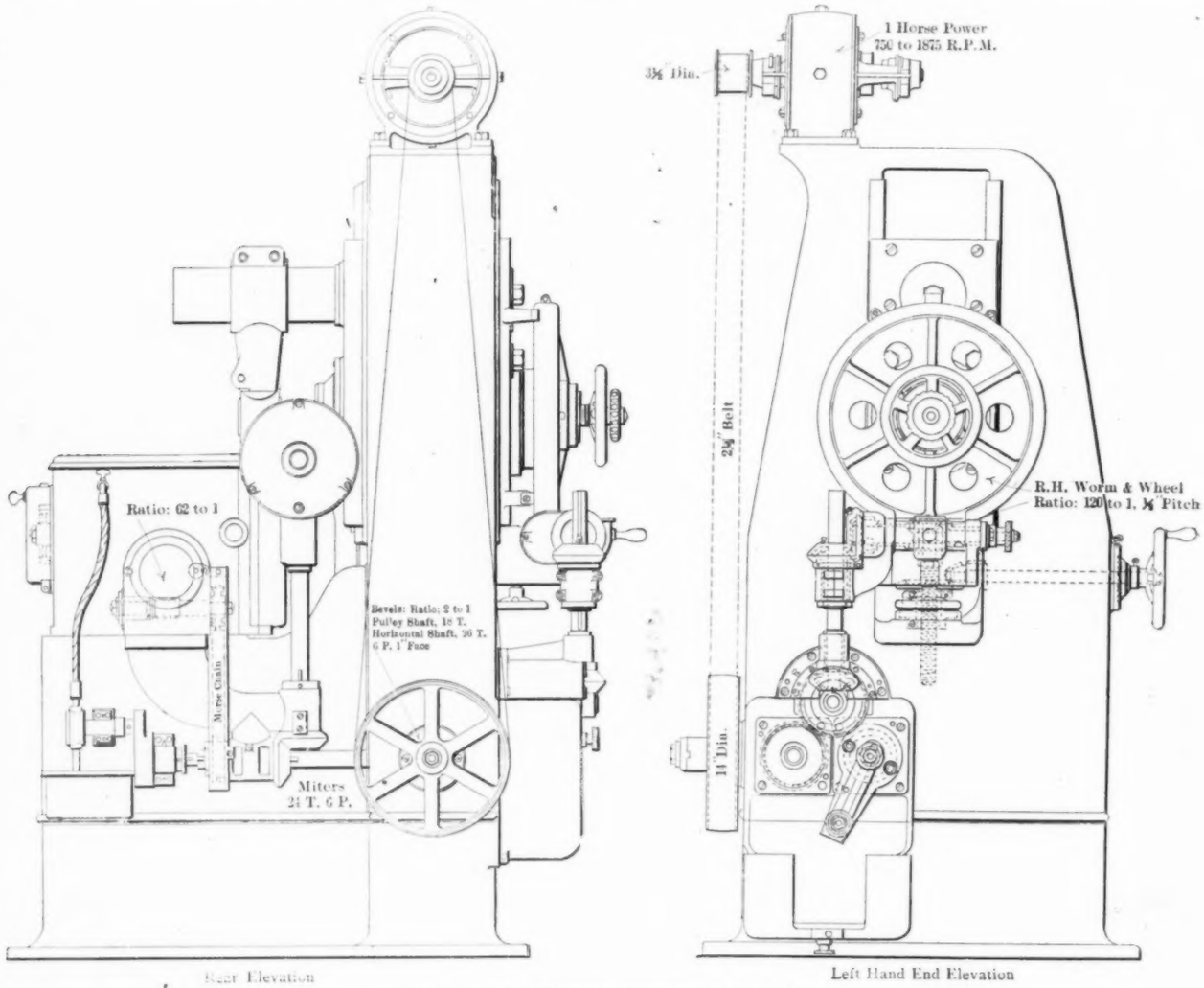


FIG. 4. WORM-WHEEL HOBBING MACHINE

Alinement of Centers

Following this comes a test to determine the alinement of the head- and tailstock centers. This is shown in Fig. 11 and is a repetition in most respects of the test shown in Fig. 10, except that in this case a test bar 12 inches long is held between centers. The tailstock has a reversible center bar with a large center on one end and a smaller center adapted for the lighter classes of work of small diameter on the other end. Both of these are tested for alinement and in the present case showed an error of only 0.0005.

Swiveling Test

Since it is expected that the dividing head will sometimes be used with the work spindle clamped in any position between the limits through which it may be swiveled, this company also makes a test to determine whether or not the spindle swivels in a plane perpendicular to the top of the table. In this test the head is set so as to bring the spindle in a vertical position. The test bar is inserted in the spindle as shown in Fig. 9. The indicator is then mounted on a stand similar to that shown in Fig. 10. This is rested against the face of the vertical surface of the test block; by taking several readings along the side of the test bar the parallel relation of the bar with the face of the vertical surface of the test block is at once determined. In the present instance the error found was 0.001 inch, while the maximum allowable error is 0.0015 inch.

Accuracy in Indexing

Every one of the dividing heads is also required to do an actual job of indexing on a test plate 8 inches in diameter, as shown in Fig. 12. This plate consists of two disks with carefully ground surfaces

clamped together on an arbor which is held in the taper hole of the spindle.

The test is made by indexing in the usual way and scribing hair lines across the surface of the disks by means of the special apparatus shown. The arbor holding the disks is then removed from the dividing head, and held in the vise; the clamp bolt is loosened and one of the disks is revolved 45, 90, 135, 180 degrees, and so on. In each case two of the hair lines are brought in exact alinement with each other, and the plates carefully clamped together; then the other hair lines are examined for alinement under a powerful magnifying glass. Their non-alinement indicates the error in the index mechanism and may be estimated to very close limits by an experienced man. In the present instance the error recorded was 0.0005 as the maximum cumulative error found in any one-fourth of the circumference of the disks. The maximum error allowed is 0.0015.

Truth of Head Center

Since accuracy in the other parts of a dividing head is of no very great value when doing work between centers unless the head center itself runs true, this part is also tested as shown in Fig. 13. The process of this is a repetition of former tests, except that here the indicator point rests against the point of the head center; when this is revolved by means of the index mechanism, the error may be read from the indicator in the usual way. The maximum error allowed on this test is 0.00025. That is to say, an error of one-eighth of one-thousandth on each side of the true position is allowed.

System of Test Gages

The above method of testing is repeatedly checked by the following plan:

Instead of scribing hair lines across the disks, slots ¼ inch wide and ¼ inch deep are milled into them. Pains are taken to make these slots exactly to gage. Then the work is removed from the dividing head and the slots are compared by lining up any two of them the same way as in the above test, except that in this case a standard gage of sufficient length to fill both slots is inserted. The alinement of the other slots is then compared by testing with special gages. These gages are made 0.00025, 0.0005, 0.00075, 0.001 inch, etc., below standard; obviously the amount that any given gage is below standard indicates the error in alinement of the two slots into which it fits snugly.

In addition to the foregoing tests, there are some others which are not shown on this sheet. Perhaps the most interesting of these is the rigidity test shown by Fig. 14. This is made before the head is entirely completed but after the swivel block and clamps have been fitted. A bar 24 inches long is inserted in the hole of the work spindle. A lever carrying a 200-pound weight on one end is then brought to bear on this bar at a point 22 inches from the swiveling center. The arms of this lever are in the ratio of 3 to 1 so that the total pressure brought to bear on the bar is 600 pounds at a point 22 inches from the center of the swivel. Every head must undergo this test without any evidence whatever of failure on the part of the clamps to hold the swivel block rigidly in position.

Cleaning and "Running In" Worm Gears

The two half-tones Figs. 15 and 16 show a corner in the dividing-head assembling department. On the bench at the left will be seen a head belted to the small motor for the "running-in" process mentioned previously. The chief object of these engravings, however, is to show the use of the large tanks of gasolene which are distributed throughout the shop available for the use of all bench workers. In Fig. 15 the workman is shown scrubbing a dividing-head spindle and worm wheel. In Fig. 16 he has closed the lid of the can (which is a tight fit) and is "blowing" the same piece of work with compressed air. This removes all excess gasolene, hastens the drying of the work and insures further the complete removal

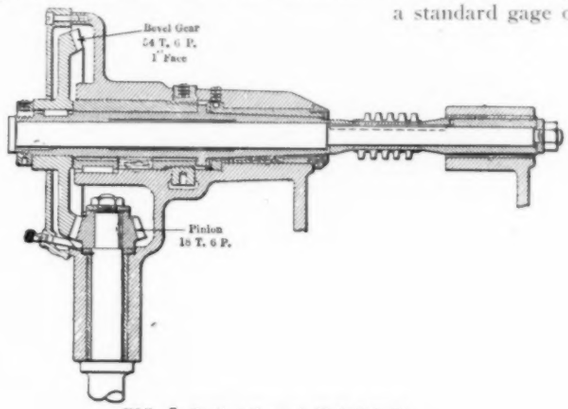


FIG. 5. Section through Hub Spindle

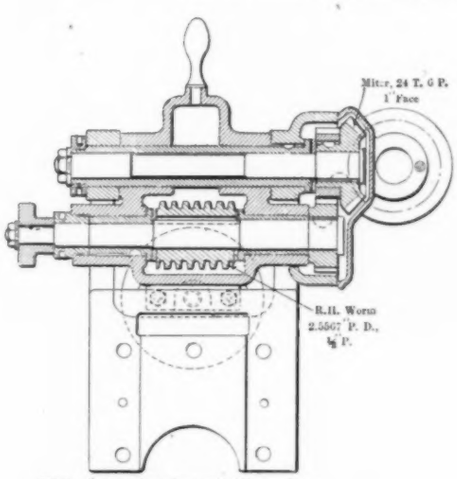
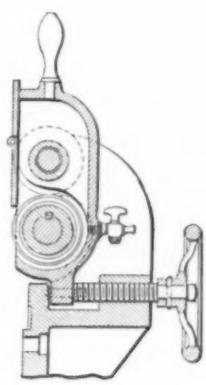


FIG. 6. Section through Worm Box



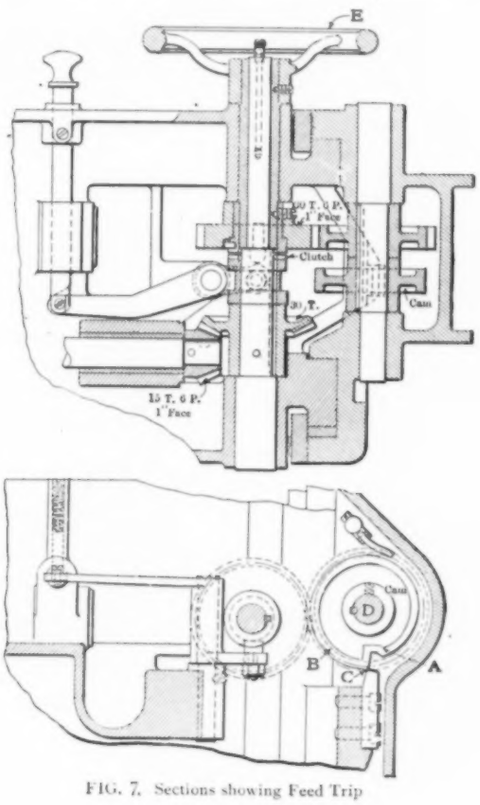


FIG. 7. Sections showing Feed Trip

DETAILS OF DRIVING AND FEED MECHANISM

of any particles of dirt that might otherwise lodge on the work. These compressed-air tubes are located at every bench and at every machine in the shop. The men are supplied with canton-flannel rags instead of cotton waste and find many uses for them; for instance, spreading a clean rag on the bench and placing on it small screws and other small parts of a piece of work that they may be assembling, as well as some of the smaller tools which they are using. The men on the main assembling floor usually lay one of these rags over parts of the machine as the assembling proceeds, to protect such parts from collecting dirt or possible injury. They also lay a rag over the table of the machine, in which case it becomes the place for laying wrenches, etc., used in their work.

The company states that it finds the flannel rags much more effective than waste; they are a better fire risk; they do not drop lint into parts of the ma-

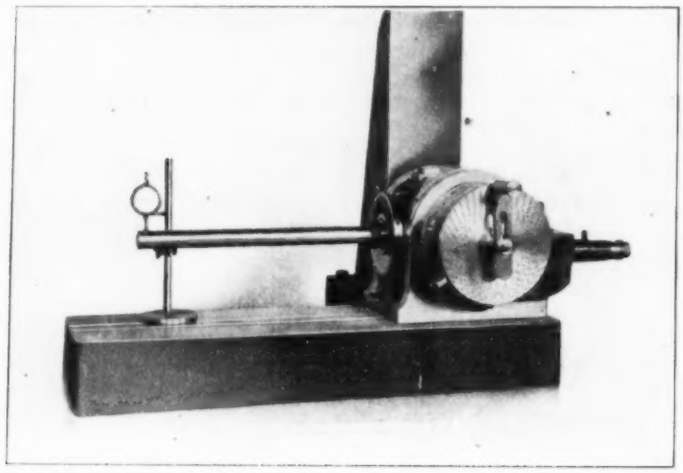


FIG. 9. TESTING TRUTH OF TAPER HOLE

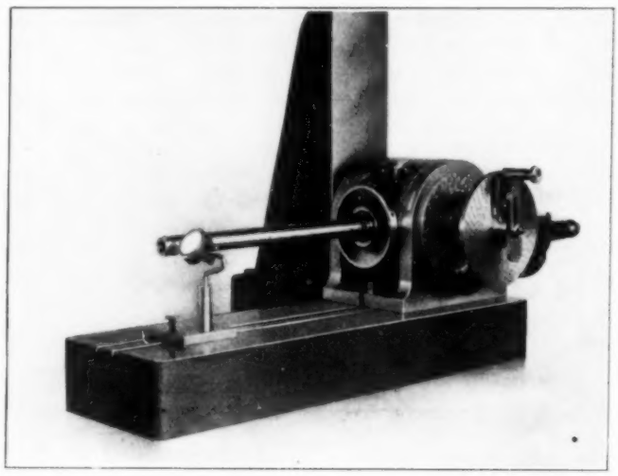


FIG. 10. TESTING ALINEMENT OF SPINDLE WITH T-SLOT

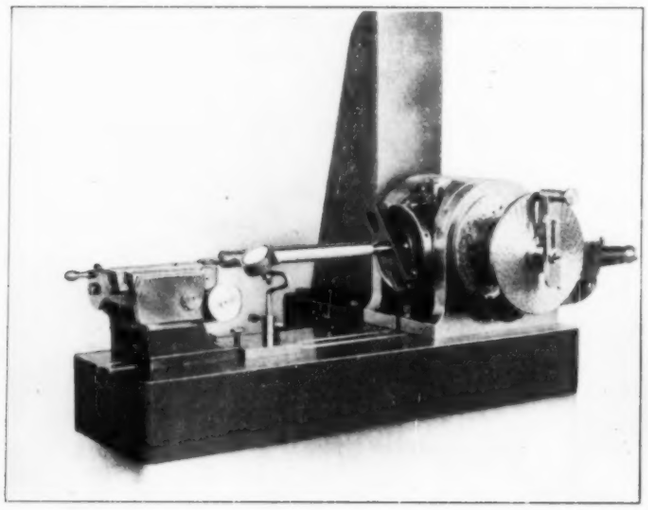


FIG. 11. TESTING ALINEMENT OF CENTERS

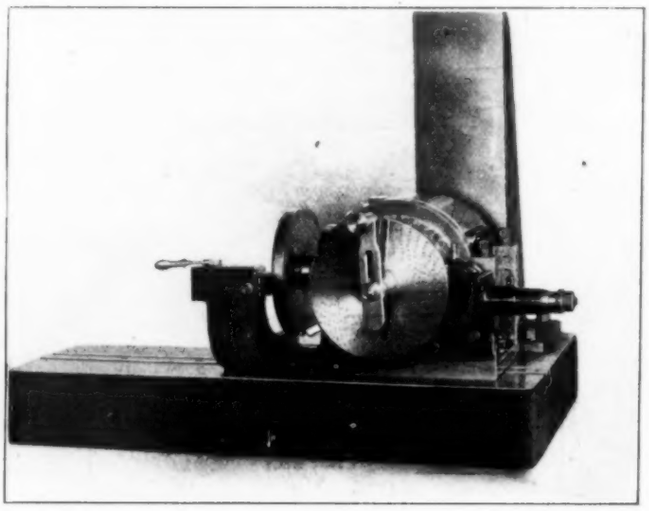


FIG. 12. TESTING FOR ACCURACY OF INDEXING

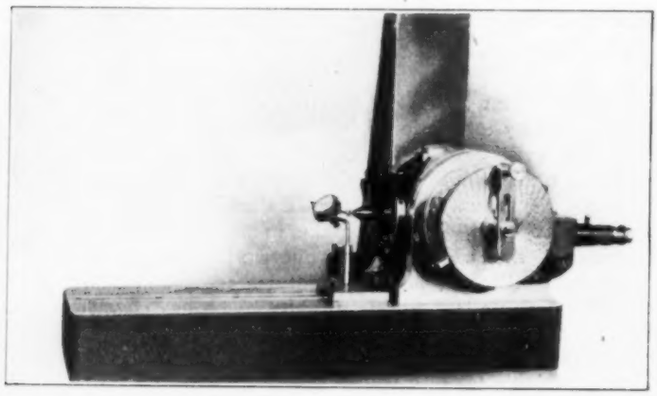


FIG. 13. TESTING HEAD CENTER

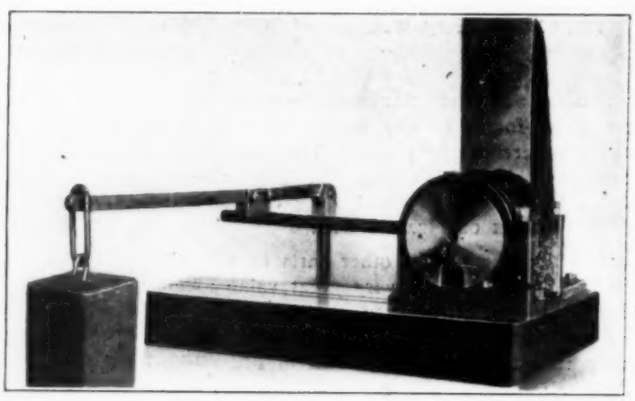


FIG. 14. RIGIDITY TEST

chine and are more durable than anything else that they can buy and are at the same time cheaper. These rags are washed every day in a laundry especially fitted up for this purpose.

Using Electric Flat Irons in an Engine-repair Job

Electric flat irons are not generally used in machine shops, but they recently came in very handy in replacing a crank-pin on the high-pressure side of a 500 horse-power cross-compound Russell engine.

The new crank-pin was six inches in diameter and had to be fitted into the crank disk which was five inches thick.

As this would have been quite a proposition for blow torches, it was decided to try electric flat irons. An iron bar 3¼ inches in diameter was placed centrally in the hole in the crank disk and a number of General Electric six-pound flat irons were distributed between the bar and the wall of the hole in the crank-pin. It took four hours to heat the crank disk sufficiently to allow the crank-pin to be slipped in. This arrangement had the advantage of providing uniform heating and of keeping the parts clean.

The tenth half-yearly bonus payment at the Remington Typewriter Factory, of Wyckoff, Seamans & Benedict, Ilion, N. Y., took place December 24, 1907. This bonus plan has become a regular fixture at the Remington works, more than $130,000 having now been distributted in this way to the most efficient of the employees who have been able to retain their positions for ten years and more. In the factory hall on this occasion $13,800 in gold was distributed among 276 selected workmen, including 2 thirty-year, 13 twenty-five year, 40 twenty-year, 84 fifteen-year and 137 ten-year men. The certificates and prizes for good suggestions, adopted during the last six months were awarded at the same time.

14643

The Cincinnati Milling Machine Co.

TEST SHEET FOR DIV. HEADS.

	Assembler's Check	Inspector's Check
Eccentric works freely	OK	OK
Spindle runs freely without worm	✓	✓
Split ring clamps spindle easily	✓	✓
Crank works freely with worm engaged	✓	✓
No shake in spindle	✓	✓
Index pins fit holes in index plates	✓	✓
No noise in gears, mitre gear bearing	✓	✓
Stop for side plate locks plate firmly	✓	✓
No back lash in gears. Limit ⅛ hole in side plate	✓	✓
Vernier flush with swivel block	✓	✓
No marred screws or oil cups	✓	✓
Block swivels 5 degrees below horizontal and 50 degrees beyond vertical	✓	✓
Smooth hole in spindle	✓	✓
Tail stock has zero line on swivel block	✓	✓
Elevating center has zero marks	✓	✓
Center in head has good bearing	✓	✓
	Maximum Error Allowed	Test in Thousandths
Front taper hole true in spindle at outer end of 18" test bar	.015"	1
Front taper hole in spindle true at nose	.0025"	1/4
Spindle in line with tee slot in table at outer end of 18" test bar	.001"	1
		F / B
Spindle central with tee slot in table front or back	.002"	1
Tail stock centers in line with Large end	.001"	1/2
Head center using zero marks Small end	.001"	1/2
Back taper hole in spindle true 1" test bar	.005"	4
Spindle perpendicular to table at outer end of 18" test bar	.0015"	1
Error in worm wheel, 8" dia. test plate	.0015"	1/2
Center runs true on point	.0025"	1/4

Shop Order 3547 *Size* 10" *Div. Head Number* 69-2287

Date Assembled Sept 5/07

Assembler's Number 311 *Name* R. Engel

Date Inspected Sept. 18/07 *Inspector* H Holz

FIG. 8. TEST SHEET

FIG. 15 CLEANING AND "RUNNING IN" DIVIDING HEAD WORM WHEELS FIG. 16

Chain-stud Recessing Machine

An Interesting Machine Built by Hans Renold for Chain Work and Which Shows Chains in Machine Design

EDITORIAL CORRESPONDENCE

There are many designers and engineers who have appreciated the great advantage chain gearing possesses for power transmission; but few have given the subject sufficient study to recognize the chain as an element in machine construction. In this respect a visit to the works of Hans Renold, Ltd., Manchester, England, will be something of a revelation, where the greater portion of the machinery used in the manufacture of their well known chains is of their own design and construction. In designing these machines, very naturally the seemingly unlimited possibilities of the various types of chain are given consideration and the right chain used in the right place. This, they point out, is most essential, as upon this selection success or failure often depends.

The visitor is struck with the simplicity with which motions that ordinarily involve trains of gearing, bevel gearing, levers and so on, changes of motion from circular to parallel, and *vice versa*, reciprocating motions, a number of motions from one source at more or less remote parts of the machine from the driving sprocket, are obtained with a chain, in a simple manner that would otherwise have required mechanism complicating the design.

Hopper Holds a Day's Work

The following illustrations and description of a recently constructed machine we had the pleasure of seeing in operation has one or two examples of the advantage of chains in machine construction.

The work of these machines is the recessing of the ends of chain studs, and their operation is entirely automatic.

Figs. 1 and 2 show the front and rear views of these machines in half-tone, which gives a good general idea of their appearance, while the details are shown in the line illustrations that follow.

Fig. 3 shows a front and end elevation. The hopper *A* is designed to hold one day's work, is filled in the morning, and the machine, except for sharpening and setting of drills, requires no further attention during the day than for a girl to watch from 12 to 15 machines, to see that no foreign material clogs or chokes the fountain. This can be detected in the fountain *B*, Fig. 1, which has an open front, partially closed with a cover hinged at the top for the purpose.

All motions emanate from one cam

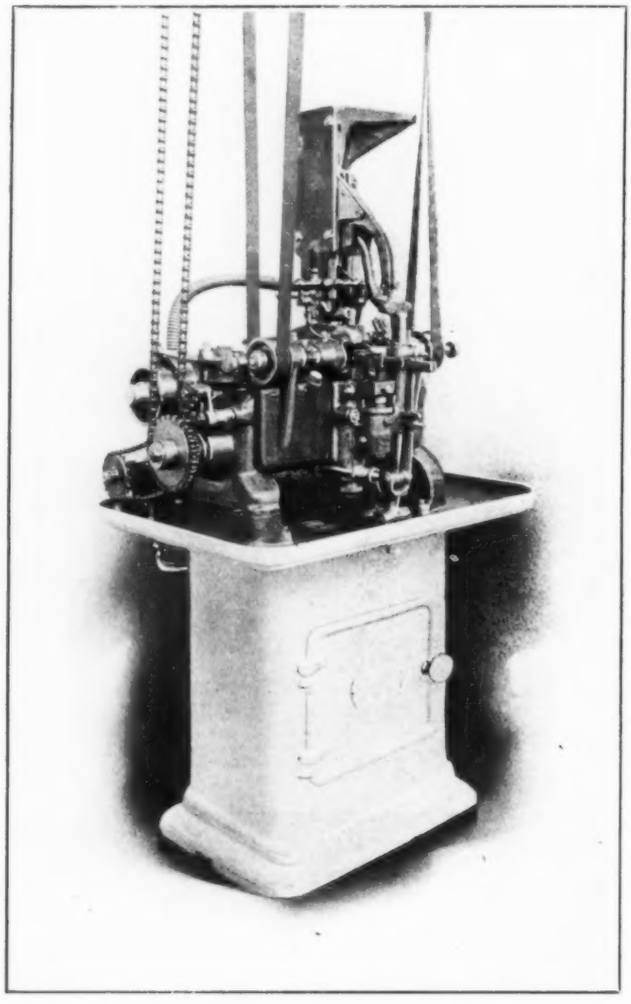


FIG. 1. FRONT OF STUD-RECESSING MACHINE

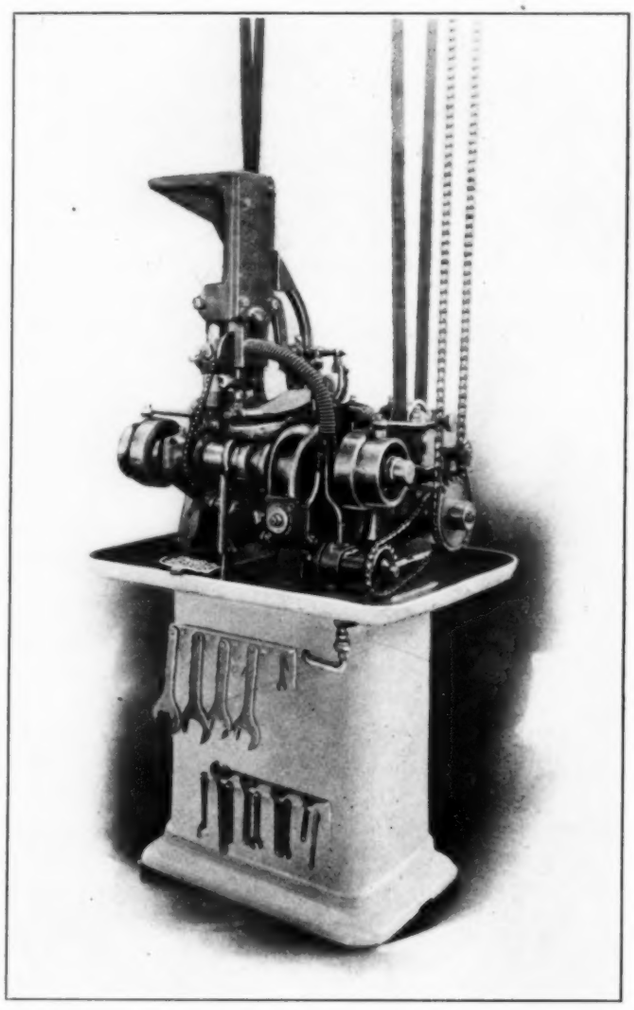


FIG. 2. REAR VIEW WITH CHAIN DRIVES

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shaft on the outside of the frame and at the rear of the machine, this shaft being carried in capped bearings most convenient for assembling and attention. This cam shaft is driven through the medium of bevel gears, worm and worm wheel. Each stud passes through the following evolutions:

1. Selection from mass in hopper. 2. Deposited on incline plane. 3. Thence to fountain. 4. Conversion from vertical to horizontal position. 5. Column in fountain checked off. 6. Fed forward and located under clamping lever. 7. Clamped ready for drills to recess. 8. Advance and return of drills to recess. 9. Ejection of recessed stud.

Where All Movements Originate

These motions originate from five cams and one chain sprocket mounted on the cam shaft alluded to. The hopper is so made as to allow the blade *C*, Figs. 4 and 5, to pass up and down through a mass of blanks. The blanks roll onto the upper edge of this blade; when the blade gets through the mass, those that are carried by the blade roll off onto an inclined plane and slide down lengthwise of the fountain *D*, Fig. 4. They are then in a vertical position and have to be deposited upon the pusher-up *E*, Fig. 7, in

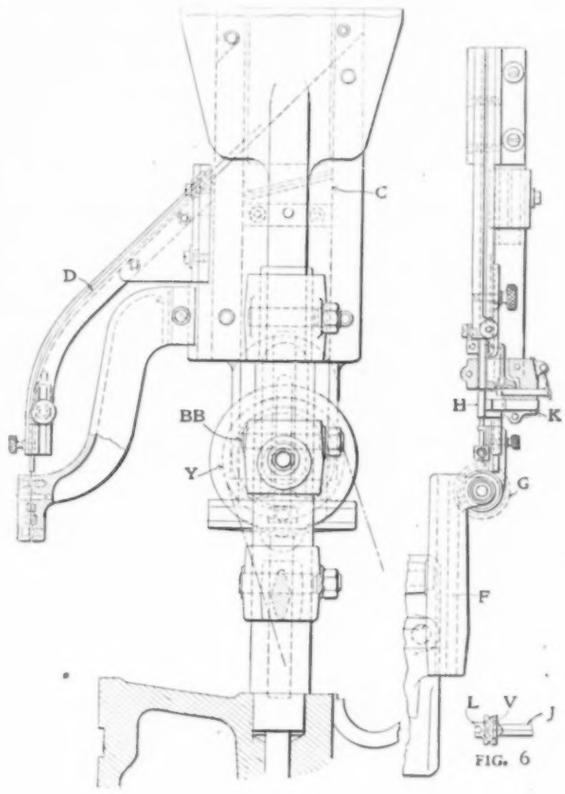


FIG. 6

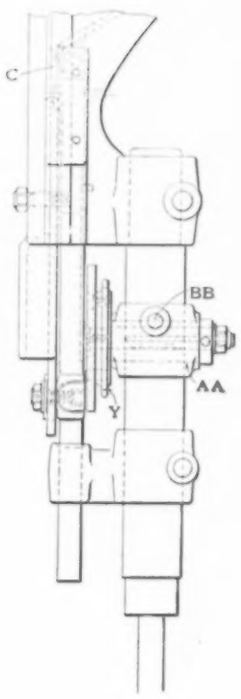
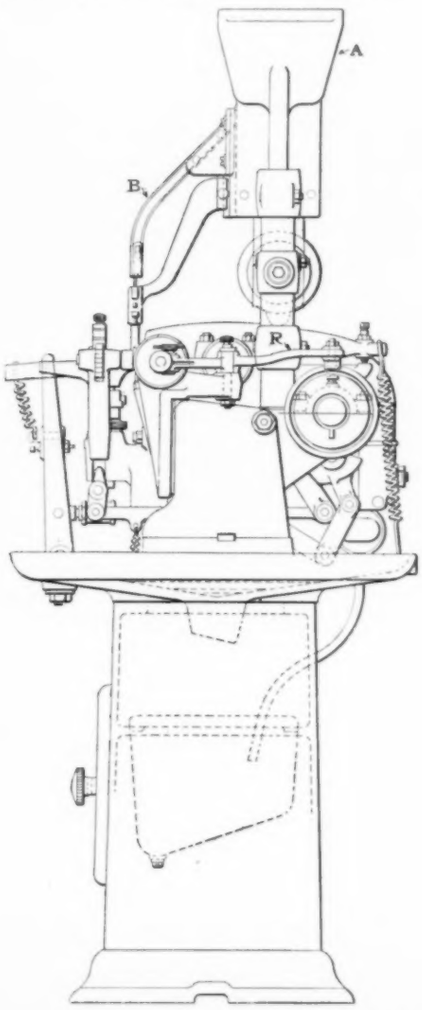


FIG. 5

FIG. 4

DETAILS OF THE MAGAZINE FEED



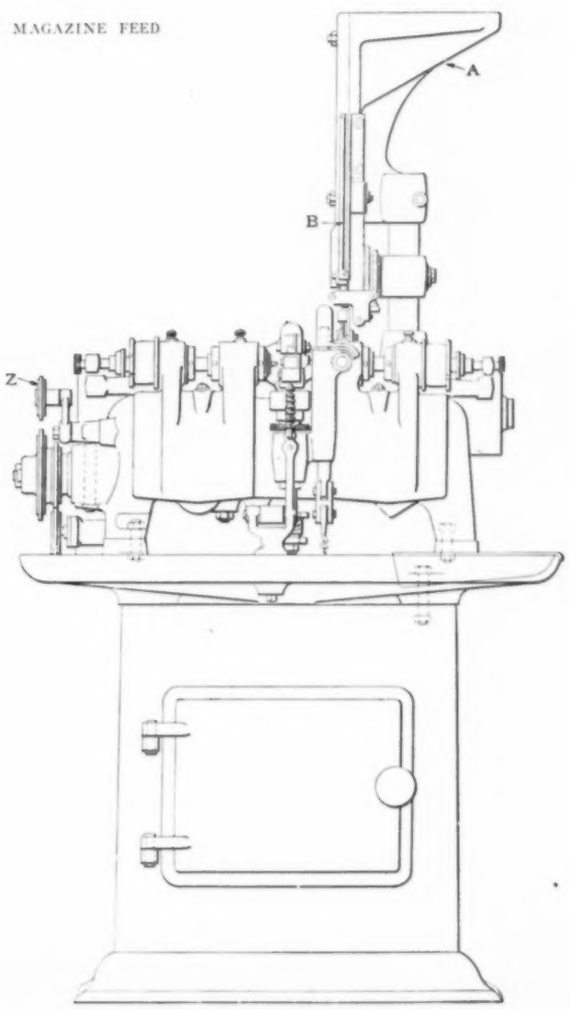


FIG. 3. SIDE AND FRONT VIEW OF STUD-RECESSING MACHINE

a horizontal position. This is accomplished by a rack reciprocating in bearing *F*, Fig. 5, operating pinion *G*, which causes carrier *H* to pass through an angle of 90 degrees. The carrier *H* has adjustable fingers, a plan view of which is shown at Fig. 6. Adjustable stops *J* are fixed at *K*, Fig. 5.

When the points *L* engage with these stops, it causes the fingers to open very slightly and allow the last stud in the fountain to drop into jaws onto an adjustable stop beneath. This locates the stud so that it will be correctly deposited upon the pusher-up. When the carrier goes away from these stops, a spring closes the jaws onto the stud, and the jaws are again opened when they get into a horizontal position through the wings *L*, Fig. 6, engaging with pins *M*, Fig. 7. The stud is then deposited into the pusher-up which carries the stud onto jaws *N*. This motion is obtained through a series of levers actuated by a cam roll at *O*. The pressure foot *P* clamps the stud through the medium of the cam and cam roll *Q*, while the two drills advance and recess the stud simultaneously through the medium of the levers *R*, Fig. 3, and cams *S*, Fig. 8. This describes the complete cycle of operations.

The Safety Device

The interesting application of chains to this machine will be observed in Fig. 1, which shows that the driving mechanism consists of an open and a crossed leather belt for the two drill spindles, and one light roller chain which drives the whole of the motions. These, it will be noticed, are all driven from one cam shaft at the rear of the machine, all three being driven from an overhead countershaft. The chain sprocket on this machine is shown in section, Fig. 9, and contains a safety device, for the reason that, with chain driving the motions are made positive, there being, of course, no slip as with a leather belt. This positive feature, while giving the greatest efficiency necessitates at the same time some provision for safety in case of mishap, such as seizing of bearings or other contingencies. A thoroughly efficient and simple device is here shown.

It will be seen that the sprocket *T* is loose upon the hub of sprocket *U*, which is keyed to the bevel-gear shaft. Bushings *V* and *W* are of hardened tool steel, with holes to admit of the correct size of wire sufficient to drive the machines but small enough to shear in case of mishap, when, of course, the machine immediately stops. It is then an extremely simple matter to remedy the cause of stoppage and merely put in a new piece of wire.

The Lubricating Pump

The great speed at which this machine runs necessitates the use of oil as a cutting lubricant; it therefore becomes necessary to have a pump attached to the machine. The adoption of a chain drive enabled the pump to be put in the most convenient position, near the delivery point and not too far from the source of supply, as will be seen in Fig. 2.

Sprocket *X*, Fig. 8, is a driving sprocket for operating the hopper slide. The driven sprocket is seen at *Y*, Figs. 4 and 5. To drive this hopper blade by any other means would either have necessitated an entirely different design or a train of spur gearing with its accompanying studs and supports.

In the chain driving of this machine there are three methods of taking care of the slack of chain. One is by an idler sprocket which swings on an arm and is applied to the slack side of the chain, shown at *Z*, Fig. 3, and also in the half-tones. The second method is shown in the pump drive, which is accomplished by means of the pump being made to slide to and fro, merely a matter of a half inch extreme movement, so adjusting the wheel centers. The third method is indicated at *A A*, Fig. 5. The spindle carrying the sprocket has its bearing in an eccentric sleeve which can be turned round and clamped in correct position by means of the wedge bolt *B B*, Figs. 4 and 5.

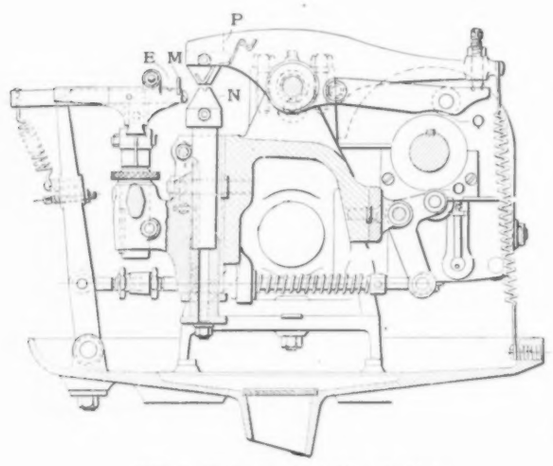


FIG. 7. Mechanism for holding the Links.

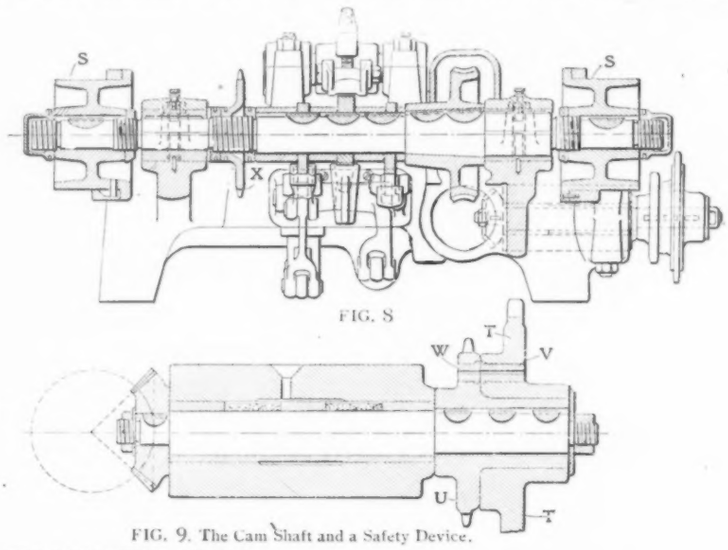


FIG. 9. The Cam Shaft and a Safety Device.

FIG. 8.

Molding a Three-way Reciprocating Valve

SOME OF THE INTERESTING DETAILS

By W. W. McCarter

The method employed in making a mold for a casting such as that illustrated may differ from the conventional three-parted flask jobs, in that the intermediate section of the flask, which is usually termed "cheek," is no longer used as such immediately after it has been lifted from the pattern; but it is returned to the drag and becomes a part of the same throughout the entire operation of coring up, securing the mold and making it ready to receive the metal.

Fig. 1 represents the valve seat to be cast, the upper part being a plan view. Fig. 2 is a phantom drawing of the pattern and a vertical section of the entire flask in which it is contained; or, by inverting the drawing, it may be assumed that Fig. 2 is a view of the closed mold into which the metal is now ready to enter.

There are four distinct features in which novelty and utility enter into combination in the method of producing the castings in question: First, the joint line of the mold; second, the partings of the pattern; third, the value of covering cores; fourth, the function of the cheek.

In the common acceptance of the term "cheek" it is generally conceded that a job to be "cheeked off" is necessarily a three-parted mold, and, in lieu of a cheek, the job must be rolled over twice in order to allow the pattern to be drawn from the sand. In the following example we have a four-parted job requiring two

cheeks if molded in the ordinary way; but as we employed covering cores over the bosses, as shown by the letters *A* and *E*, it made it a three-parted job, as illustrated by Fig. 2. If a covering core were employed at that protuberant part of the pattern *C*, a part of which forms the valve seat, the job would be only a two-parted one.

The partings which refer to the pattern are indicated by the letters *B*, *C* and *D*. The joint lines, or partings between the cope, drag and cheek, are indicated by the heavy black lines, some of which intersect the partings *B* of the pattern. To avoid confusion there are several arrow points placed at the joint line between the cope and cheek, which reaches the drag at *D*. They indicate the direction in which the pattern is withdrawn from the cope; their reverse direction indicates all the sand contained in the cope.

In beginning the job there is an "odd side," or "match," conforming to the joint line, as indicated by the arrow points. This "odd side" receives that part of the pattern which comes in the drag, exclusive of the two loose pieces above *C* and *D*.

The cope part of the pattern is now placed in position on the match and the sand rammed up to the top of the pattern, which in this case is the core prints *A A*, at the three bosses, two of which are shown in the cope in Fig. 3. These being rammed up, they are withdrawn and the covering cores *A A* are supplied in their place. The remaining depth of the cope is now rammed up over the covering cores *A A*, the job rolled over and the "odd side" removed. The loose pieces of the pattern above *C* and *D*, which carry their respective core prints, are now placed in position on the body of the pattern. The joint which was made by the "odd side" now receives the usual supply of parting sand, the cheek is rammed up and the joint is made over its entire area, as indicated by the line at *D*. Parting sand is then applied, and the drag is rammed up with the covering core *E* placed in the same manner as the covering cores *A A* were placed in the cope.

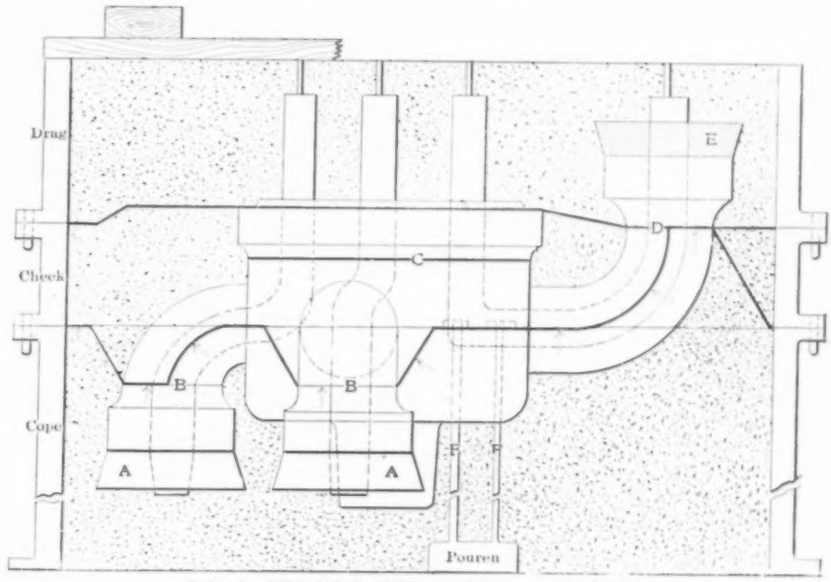


FIG. 3. THE MOLD WITH PATTERN IN POSITION

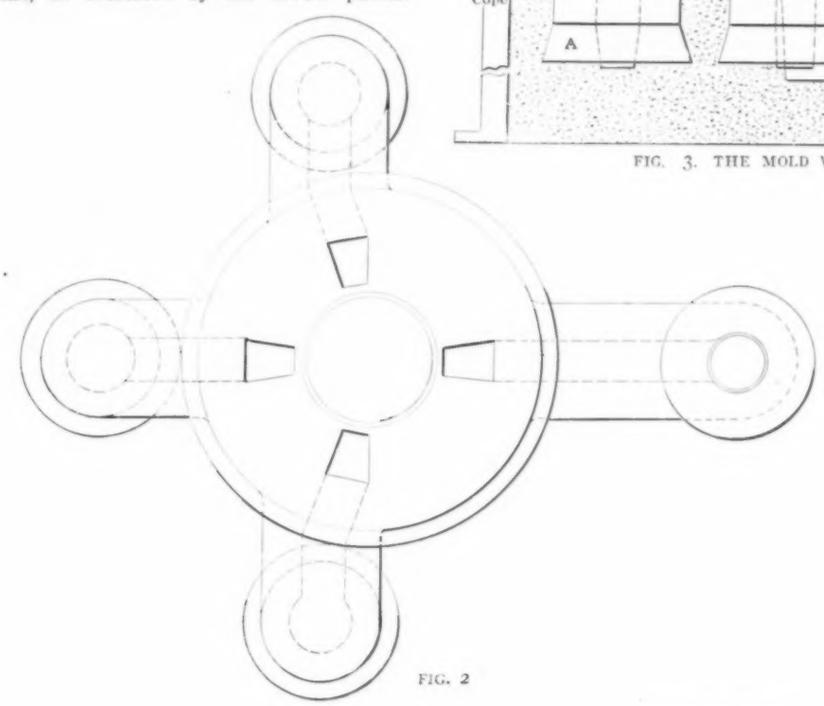


FIG. 2

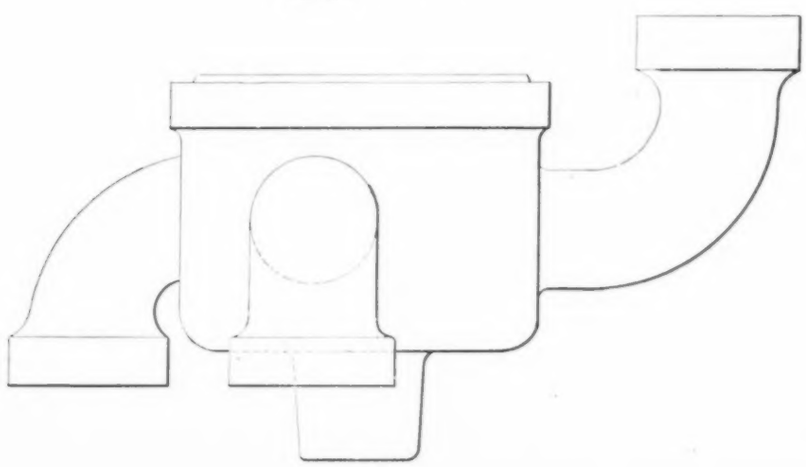


FIG. 1
RECIPROCATING VALVE TO BE MOLDED

The drag is now lifted off, bringing with it the valve-seat pattern above the line *C*, and of course the cavity of the loose piece above *D* and the covering core *E*, as previously explained.

The drag is then inverted and permanently placed on a bottom board; that part of the pattern contained in it is withdrawn. The body of the pattern which remains in the cheek and cope is rapped lightly to facilitate lifting the cheek from it, which (as stated in the beginning of this article) becomes a part of the drag immediately after it has been lifted from the pattern. The "punch" gate is then made by pushing two half-inch rods through the cope at *F F* and subsequently cutting the pouren. Drawing the body of the pattern from the cope, however, precedes cutting the pouren.

It may now readily be seen that after the cores are placed, the cope is to be lowered and the mold placed in an inverted position to that shown in Fig. 2; the mold is now secured, or "clamped up," and is ready to receive the metal with a minimum amount of handling.

Machining a Turret-lathe Turning Tool

Some Jigs and Fixtures That Are Indexed to Set the Work at the Proper Angles While Milling and Drilling

BY A. J. BAKER

The tools here described were designed for the manufacture of roller steady-turning tool brackets as used on the hexagon turret lathes of Messrs. Alfred Herbert, Ltd., Coventry, England, by whose permission the accompanying drawings are reproduced. They were designed by the tool-drawing office and are a fair sample of the tool practice of this concern.

Fig. 1 shows the bracket in detail. It is of malleable iron, turned and faced on the back to suit the turret face, to which it is held by screws in the holes *A*. The 55-degree dovetail guide forms a bearing for the tool-holder slide, which is moved toward the work by means of a spur gear on a shaft fitting in the 1-inch vertical hole *B* and engaging with a rack on the back of the tool slide. The two T-slots *C* and *D* are also slideways, down which move the roller carriers, actuated by collar-head screws in holes *E* and *F*. The four holes *G*, *H*, *I*, *J* are used in connection with the locking device, which simultaneously locks both of the roller-adjusting screws.

Through the holes *K* and *L* a supply of lubricant is carried to the tool. The main 2⅛-inch hole *M* is bored out to the same diameter as the holes in the turret face and carries steady bushes, etc. So much for the work; now let us consider the methods of making.

Boring, Turning and Planing

The first operation is that of boring the main hole *M*, turning the check piece or hub which centers the device, and facing the back. This is accomplished in a special fixture (not here shown) mounted in a 24-inch lathe.

The second operation is planing; the fixture for this is shown in Fig. 2 and calls for no special comment. The turned hub of the bracket fits into the hardened ring *a* in the body of the fixture, and the clamping bolt goes straight through into the T-slot of the planing-machine table, thereby clamping work, fixture and table solidly together.

The boss *N*, Fig. 1, on the work is pressed against the headless screws *b* in the fixture by the square-head screw opposite. This lines up the slide casting with the setting piece *c*. This piece is of cast steel, hardened and accurately ground. It is made in sections, as shown, merely to facilitate grinding. The lower nut on the clamping bolt is simply to prevent the bolt being moved and so causing the washer to foul the sides of the work. Care is taken at this operation to get the 1/16-inch flat *O*, on the lower corner of the 55-degree guide on the work, at the correct distance from the center line of the bracket, as this forms the locating point of the subsequent operations of milling and drilling.

Milling Fixture

The third operation is the rough milling of the faces *P* and *Q*, Fig. 1, and the gashing of the T-slots *C* and *D*. For this the fixture, shown assembled in Fig. 3, and in detail to smaller scale in Fig. 4, is used together with milling cutters, shown in Fig. 5. The fixture consists of an angle plate *d*, a base plate *e* and a dividing plate *f* to which the work is attached. The base plate is so arranged that it may be used either vertically, attached to the angle bracket, as shown in the assembled drawing, or bolted direct to the milling-machine table. The upper part of the base plate *e* is bored out, as reference to the details, Fig. 4, will show, to form a circular V-bearing. Extending into this is a slightly narrower parallel V-bearing in which the cast-iron shoe *g* slides; the shoe forms the other half of the bearing and also locks the rotating plate *f* when the handle *h* is turned.

This construction has the merit of pulling the dividing plate firmly down into the base, and the bearing, being relieved as shown so that it bears at four points only on the plate, will not develop shake as soon as slight wear takes place. The dividing plate is bored out to carry a

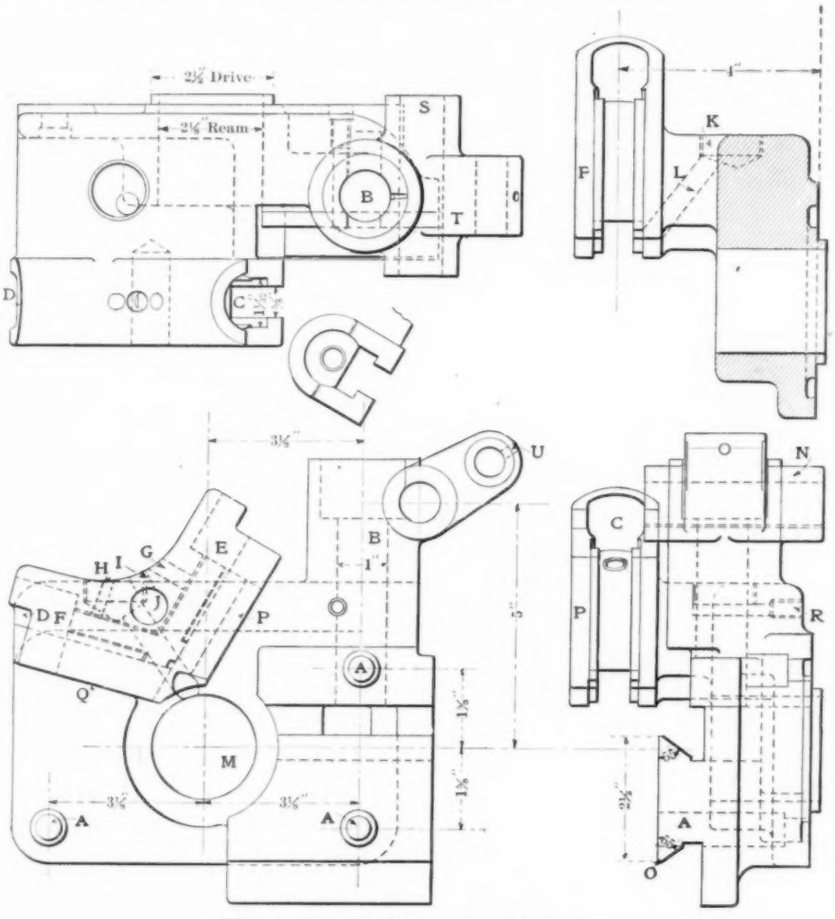


FIG. 1. THE BRACKET TO BE MACHINED

locating ring similar to that used on the planing fixture, Fig. 2. The cast-steel stop piece *i* for the 1/16-inch flat *O*, Fig. 1, previously referred to, to rest against is tongued and screwed to lug *j*. On lug *k* are three setting blocks for locating the cutters. The block *l* slides in the ½-inch slot in the dividing plate. The indexing bolt *m* is of cast steel, hardened and ground, and is fastened to the machine-steel pivot block *n*; it is forced into engagement in the notches in the dividing plate by the cam *o*, which is also of cast

steel, hardened and ground. It will be noted that when the bolt is locked home no strain comes either on the pivot block or pivot, so that the accuracy of the divisions will not be impaired by wear. The threaded clamping handle *h*, immediately above the cam, pushes the shoe *g* up to the dividing plate.

Operation of the Milling Fixture

The milling fixture is used as follows: It is mounted on the angle plate (which is in turn bolted to the horizontal milling-machine table), as shown in the assembled drawing, Fig. 3. The block *l* is drawn back in the slot to the extreme left-hand position. The *u* washer is then removed and the work slipped over the clamping bolt till the locating hub on the work fits into the locating ring *p*: the washer is then replaced, the nut screwed up slightly and the work turned round in the locating ring in a clockwise direction until the 1/16-inch flat *O* on the edge of the dovetail on the work rests against the edge of the stop *i*. The block *l* can then be slid to the right-hand position in the slot, bringing the nurled-head screw *q* against the boss *N* on the work, against which it is tightened. The clamping nut is then securely locked and the roughing cut taken off face *Q* of the work, with a ¼-inch end mill cutting on the face. The fixture is then rotated to the second division and the face *P* rough milled.

The end mill is then removed and the plain part of the T-slot roughed out with a slide and face mill 0.620 inch wide mounted on a short arbor; it is then finished with a second cutter 0.625 inch wide. After the batch of brackets has been treated as above, the fixture is taken from the angle bracket and fastened directly to the machine table. The backs of the T-slots are then roughed out with the 1.031-inch slotting cutter *r*, Fig. 5, mounted on a special threaded end arbor supported in an over-arm bracket. Fi-

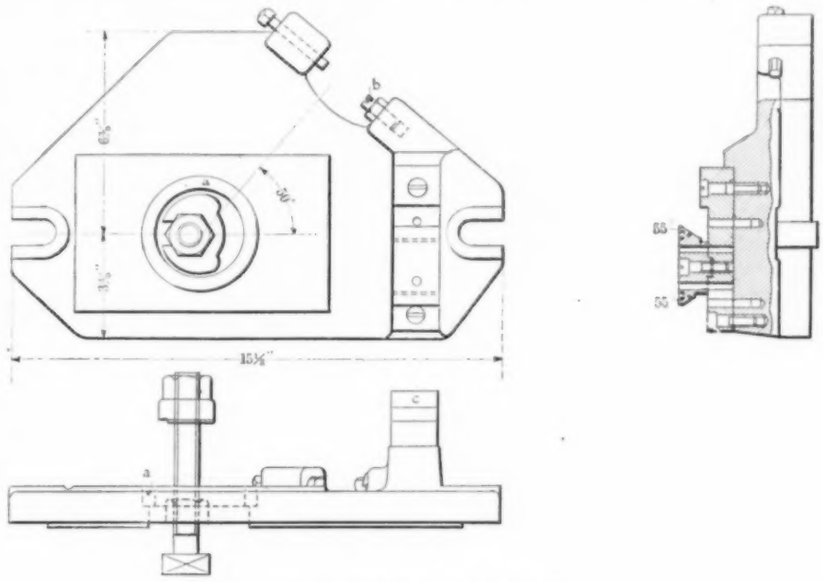


FIG. 2. THE PLANING FIXTURE

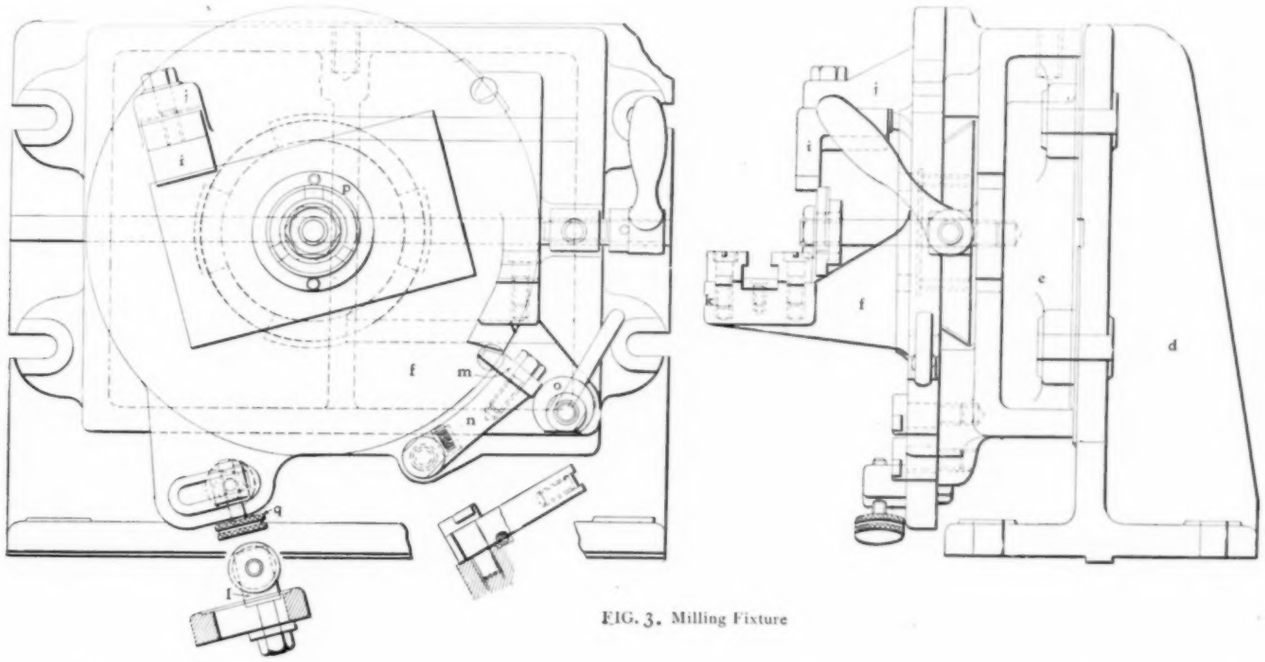


FIG. 3. Milling Fixture

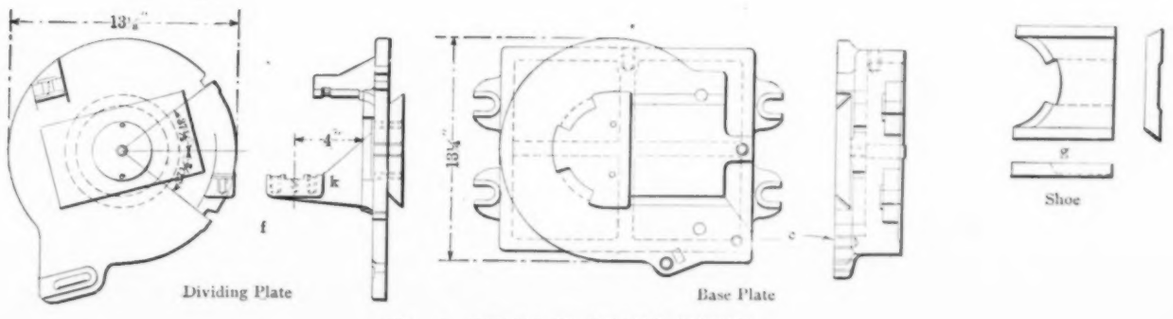


FIG. 4. DETAILS OF MILLING FIXTURE

nally, the backs of the T-slots and the faces *P*, *Q* of the bracket are finish milled with the adjustable combination cutter shown at *s*.

In this cutter the smaller mill is screwed fast on the arbor and the larger cutter (which is slack on the threaded part and tight on the parallel part of the arbor) is adjusted up to the right distance and then locked. This completes the milling operation.

The Drilling Jig

The next operation is that of drilling, the jig for which is shown in Fig. 6. The work has to assume 11 positions with reference to the drilling-machine table in order that all the holes may be drilled at the various angles called for by the design of the bracket. It was considered advisable to make one jig to attend to all the holes at one setting, instead of a number of less elaborate jigs without the indexing arrangement incorporated in the present jig, for the following reasons:

1. That the time lost in changing tools would be very small, as the Grönkvist chuck being employed, all tools (with the exception of the large counterbore for the vertical hole *B*, Fig. 1) were inserted and removed without stopping the machine.

2. That if the jigs were made without any indexing arrangement, at least four would be required, the cost of which would probably be greater than that of the one shown.

3. That with a series of jigs there would be risk of error in locating.

4. There would also be loss of time due to repeated handlings.

The jig is composed of the base plate *a*, the dividing plate *b*, work plate *c*, and separate steady block *d*. The work is located on the work plate in precisely the same manner and by the same locating spots as in the milling fixture, the only exception being that the stop piece swings up out of the way when the work is being lowered to its seat. This is done so that the drill bushes may be as close as possible to the work, which of course prevents its being rotated to the stop. The work plate *c* rotates on the dividing plate *b*, and can be locked to it in any position by the bolt in the circular T-slot turned in the top face of the dividing plate. A similar T-slot is turned in the vertical face of the dividing plate, by means of which it is clamped to the uprights on the base.

Two steel dividing rings, one with seven slots for the horizontal face and one with four slots for the vertical face, are screwed and doweled to the dividing plate. In these slots two steel spring plungers engage, which can be withdrawn and held out of engagement by the cam handles. The two trunnions screwed into the ends of the dividing plate rotate in the uprights of the base plate.

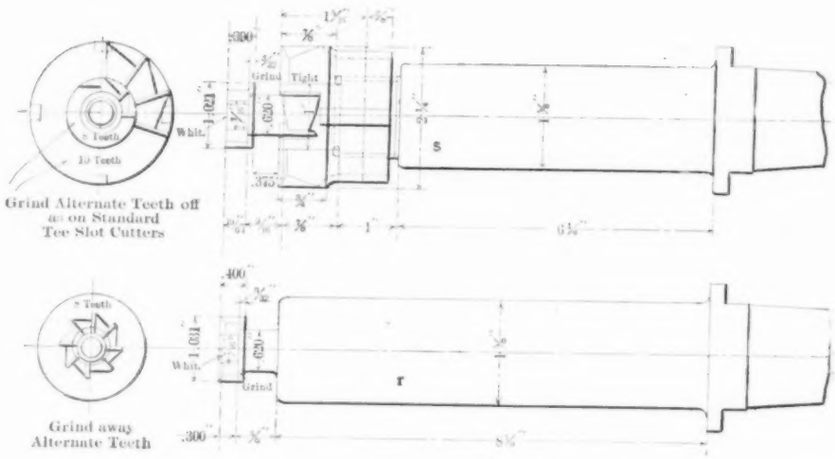


FIG. 5. THE T-SLOT CUTTERS

Use of the Jig

The work is clamped in place with the jig in the position shown. The dividing plate *b* is rotated around its trunnions through 180 degrees and the three holes *A*, Fig. 1, drilled, the hole *R* spotted, the hole *S* drilled, reamed and boss faced on the lower side, and the hole *T* drilled, reamed and counterbored.

The dividing plate is then rotated back through 90 degrees and the hole *B* drilled, reamed, counterbored and faced. The steady block *d* is then dropped over that

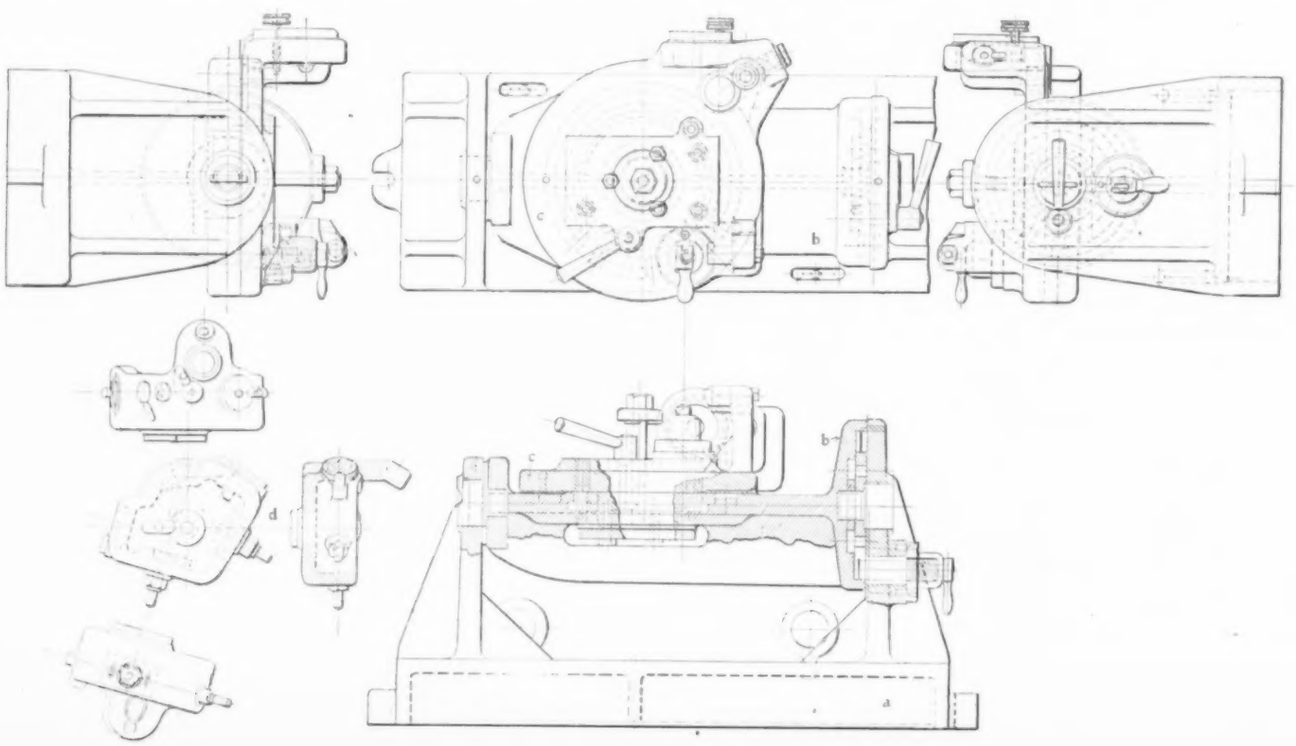


FIG. 6. THE DRILL JIG

part of the work wherein the T-slots are cut and by the two nurled-head T-bolts clamped to the work face.

On the inside of this steady block (which is practically a box with the bottom knocked out) are two steel tongues which fit in the T-slots and against the faces of the work. The two T-bolts which are drawn back into the clearance recess in the middle of the tongue are now pushed forward and turned quarter way round so that their heads engage with the back of the T-slots; by tightening on the nuts the block is locked to the work. The work plate *c* is now rotated to each of the various positions, and the holes *U, E, F, G, H, I* and *K* in the work are finished.

The dividing plate *b* is then rotated forward through 51 degrees and the hole *L* drilled. After this the plate is returned to its original position, the hole *J* drilled, holes *A* counterbored, the boss through which hole *C* is drilled faced on its upper end, and end *T* counterbored, so finishing the job.

Echoes from the Oil Country—A Drill-press Specialist

There were three boys in the family. The oldest of them was not a very rugged boy, but he was keen witted and active. He was not strong enough for the hard work of the farm or the lease, but was a favorite of an uncle who lived near. This uncle was a man of affairs who had large interests in some oil properties; as the leases all had to use engines and other machinery, and as these things caused him to be a regular patron of the machine shop, he was well known there. Through his influence Alfred was given a job in the shop and a chance to learn the trade. He took to it readily and gave promise of being better than the average machinist. The fact that he made such a good record for himself made it easy for his brother to get in when another boy was wanted. Alonzo had visited Albert in the shop on numerous occasions and likely had heard some glowing descriptions of shop and town life as compared with country life and lease and farm work.

Alonzo was quite different from Albert. While he was not so quick-witted, he was stronger and seemed to like to take hold of the rougher work. He fitted into a place in the shop without trouble, and it was soon seen that he might ultimately make as valuable a man as Albert, although it would be in a different way. After a time the boys began to speak for a place for the third boy of the family, and gave glowing descriptions of the size and strength of John. While John was the youngest, he was much the largest and strongest. He was so bashful that the other boys had to do most of the talking for him; but as they had done so well in the shop, and as John seemed anxious to get in, he was taken on to learn the trade as the other two had been.

While it was realized from the start that John was "green" as compared with the other two boys, yet it was thought that they could help him along enough to make up for most of that until it had a chance to wear off; but it did not take much time to bring out the fact that John was entirely different from the other boys.

In this shop, when a boy was taken in with the understanding that he was to learn the trade, he was generally given plain drill-press work as his first machine work. It would come as part of his work of helping around, and his success at it would serve as a pointer to indicate how fast it was safe to put him at lathe or planer work. John never got beyond the plain, rough drilling. The few times when he was tried on some plain lathe work the results were so disastrous that it was stopped. He was willing, and a hard worker, but even his brothers were forced to the conclusion that John was not cut out for the machine shop, or at least not as a mechanic.

An apprentice was given 50 cents a day; but as it was realized that it was not right to keep a boy in that class who was not considered capable of learning the trade, John's wages were raised to a dollar a day—and he was only "working" in the shop.

One day John quit and went to Pittsburg, and it was not long before word came back that he had a job at two dollars a day. This was not so strange, as he was a large, husky fellow; but when the men heard that it was in a machine shop, they did a lot of joking about his good luck.

"Write and tell him to hang on to that job just as long as he can," said a man to one of his brothers; "the lightning may never strike him again."

There was no doubt that the general impression was that his getting the job was a matter of luck, and that it would be still greater luck if he was able to hold it. Even his brothers shared in the general belief.

Time went on; from time to time word drifted back from John, and from the other two boys who had left after finishing their time and had also gone to make a place for themselves in the world. From these reports it appeared that John had succeeded in making a more permanent place for himself than either of the other boys had been able to do. He had stayed at drill-press work and had finally got where he was in charge of all that work in a large manufacturing shop.

The oldest boy turned out to be somewhat of a rover. Because he was a very skilful workman, he did not have any trouble in getting a job wherever he was known, or in holding one as long as he chose to keep it. On one occasion he drifted back to the old town; the boys in the old shop were inquiring about the other brothers, and in particular about John.

"John surprised me as much as he did any of you," Albert said. "Even when I worked in the same shop with him, I thought that I was much the better man. In that shop a first-class drill-press man got the same wages as a lathe man or any other machine man, and a man who hired out as an all-round man had to work on any machine where they needed him. One day they needed a lot of drill-press work and I was put over on a drill press. It happened that I was alongside of John and on the same class of work. I fancied that John was a little bit conceited about what he could do on a drill press because he had been used to working against men who were not really mechanics, and I thought that it might be a good thing to let him see what a first-class man could do at it.

"I started in as soon as I got my bearings and the feel of the work and the machine, to make a record. I never worked so hard in all my life as I did at that job. At first I did it to show John what I could do, but I kept it up because I was ashamed to do anything else; for when I was doing my very best, John was doing twice as much as I was and seemed to be doing it easy. I was darned glad that he didn't turn in and work as hard at it as I had to. I worked alongside of him for several weeks and hadn't any conceit left when I got through. It was hard to get a job anywhere else just at that time, but I was ready to quit when they moved me over on to a lathe and I had a chance to rest up.

"John isn't as smart as he might be, but he is smart enough to stay right at drill-press work. He quit those people once because they wanted to give him a lathe to run. The foreman told him about it in the evening; he didn't come in in the morning, but just went and got a drill-press job over at the locomotive works.

"You know that I have been around quite a bit and worked in a good many different shops. When I meet him and get to telling him about the shops, he will go to sleep on my hands if I talk about anything but the drill-press work. He will listen to that just as long as I can tell him anything. He gets good money and earns every cent of it, and he always has a job."

W. OSBORNE.

The general conditions of electrical export trade continue satisfactory as revealed by the figures for October. It would appear that for the ten months ending with October this year the total electrical exports were $14,864,463 as compared with $13,813,822 in 1906. This is a gain of over $1,000,000. It was all in heavier electrical machinery, as instruments fell off about $140,000, while machinery increased from $7,010,068 to $8,197,143.—*Electrical World.*

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Another Wabble Drill

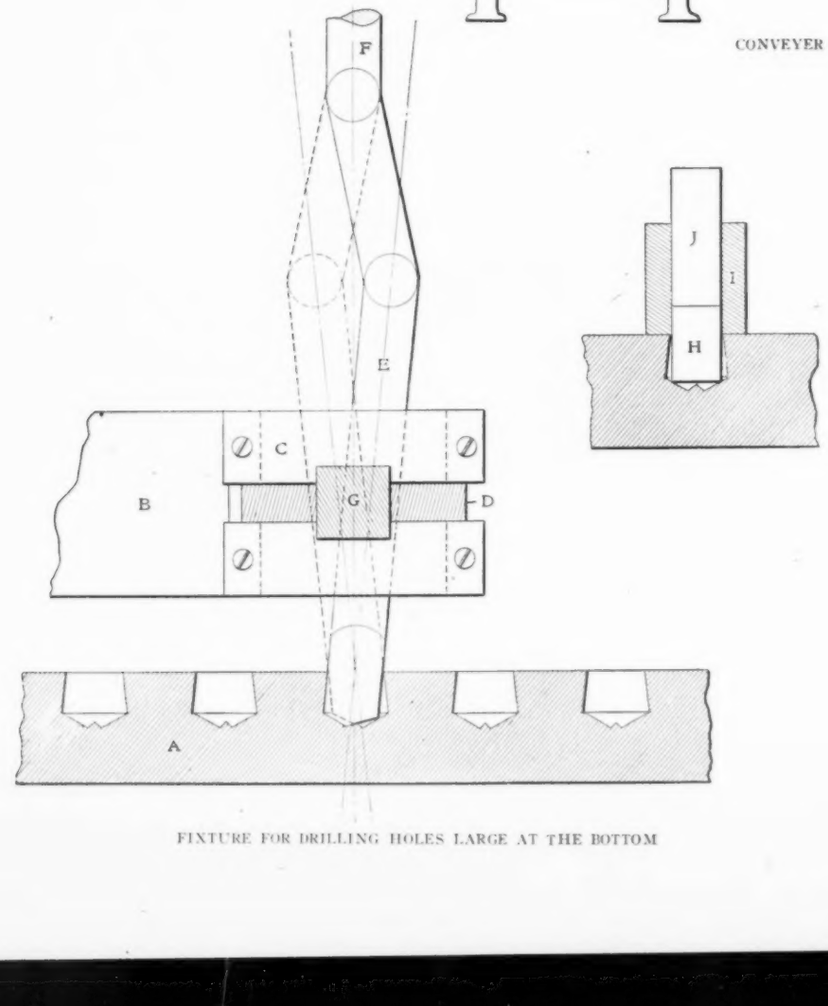
There have been quite a number of wabble drills shown in the AMERICAN MACHINIST from time to time. The one here shown was to produce holes which tapered gradually and were intended for the reception of babbitt metal. As there were several hundreds of holes to drill, the making of this special fixture was warranted.

A is the plate to be drilled. A bracket *B* was made to fit the slide on the drill press, an ordinary 25-inch back-geared drill press with sliding head. The outer end of this bracket carried a rotating piece *C*, which had a worm gear *D* formed on it. A diagonal hole was put through the piece, a sliding fit for the drill socket *E*. In the illustration the socket is not shown, the drill point being formed on the end of the bar. The top of the drill socket connects with the drill spindle *F* through universal joints.

A worm *G* (mounted on a horizontal shaft not shown) rotates the worm wheel *D* and of course *C*. The shaft on which *G* is mounted is driven from the feed shaft of the drill press. The bracket *B* remains stationary once it is set to correct hight. The feed is of course through the spindle. The plates were spotted on another drill press first and the holes finished with the fixture shown.

The babbitt was put in in two ways. In one plate it was poured after walls of clay had been built up around the holes. In the other plate short cylinders of babbitt *H* were placed in the holes. A collar *I*, polished smooth inside, was put over the babbitt *H* and the punch *J* was struck with a hammer. This forced the babbitt into the bottom of the holes and compressed it at the same time. This latter method was adopted on all subsequent plates, as it gave better and cheaper results.

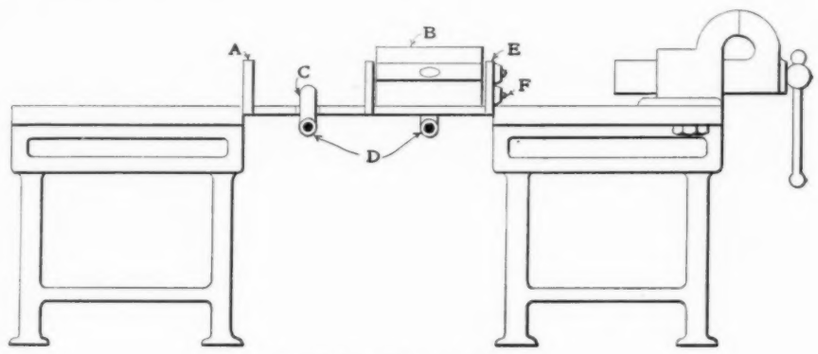
New York, N. Y. E. A. DIXIE.



FIXTURE FOR DRILLING HOLES LARGE AT THE BOTTOM

A Conveyer for Small Tools

Some years ago, while with a well known company, whose product comprised many small interchangeable parts, I was frequently witness of the inefficiency of bell or errand boys. No matter how many were on the pay-roll, the men had to waste a lot of time waiting for tools and supplies.



CONVEYER FOR SMALL TOOLS

The next time I am in a position to have a voice in the design of a plant, I will install some sort of conveyer system, as shown by the sketch. *A* is one of a pair of wooden troughs which run to the tool supply and stock rooms. Under the troughs runs an endless cable *D*, carrying fingers *C*. The troughs are made to fit one size of the well known steel tote boxes *B*, as common in shops of the above mentioned class.

When a machinist wants anything from any of the departments mentioned, he drops his requisition into the box and places it in the right direction in the trough in which the cable runs. Tote boxes of a certain distinctive mark go only to a certain distinctive department. A button *F* signals to the proper department, and an attendant at the window takes all boxes as they come along. When the attendant returns the box to the conveyer, he rings the check number on a bell covering the group in which the machinist works.

It is obvious that means must be provided to insure the box being taken off at the intended point, etc., but such details can be solved in a number of simple ways. Such a conveyer would cost only a mod-

erate sum and would furnish better service than a large number of boys. It is understood that the tote boxes slide along the bottom of the trough, just as they do on the floor when propelled by the boy.

Detroit, Mich. P. G. ROBERTS.

[These carriers can be made so as to deposit boxes or packages at the desired point whether anyone is there or not. We have a system which picks up from and delivers to three separate points so that each department gets only its own material. It saves boys, time and patience. —EDITOR.]

Drilling Holes Crosswise through Round Rods

The screws shown in Figs. 1 and 2 are the kind I am fond of making for experimental apparatus and for tools and fixtures for my own use, having usually to make but one or two at a time; but the difficulty of getting the cross hole drilled central is somewhat against this type of construction. A jig might be used, but the variety of lengths and diameters of screw heads and diameters of handle bars would necessitate having quite a number of jigs.

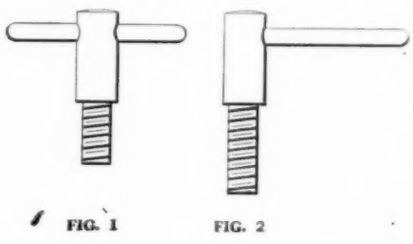


FIG. 1 FIG. 2

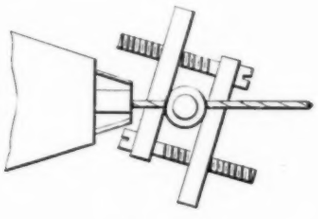


FIG. 3

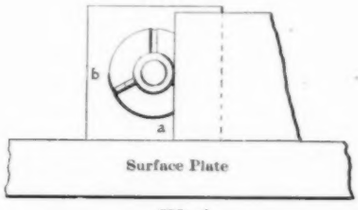


FIG. 4

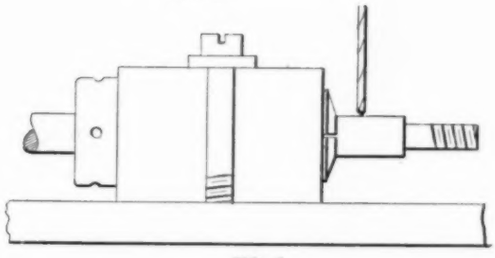


FIG. 5

DRILLING HOLES CROSSWISE THROUGH ROUND RODS

At first I made the screw on the end of a long rod, and before cutting it off would center punch the place where the cross hole was to go. Then with a dog clamped on the rod as a means of holding it in my hand, I put a small twist drill in the lathe, letting it stick out of the chuck as far as possible, so as to be very springy, and drilled through the rod by forcing it against the drill with the tailstock screw. If the small springy drill was not started central with the rod forming the screw head, the latter would tend to roll around under the pressure applied; anyone with a fairly sensitive touch in the left hand can balance a round rod on a flat drill plate so that there is no tendency of the rod to roll one way or the other.

After drilling a small cross hole, it can be inspected; if found to be not quite central, it can be "doctored" when it is enlarged to its final size. By placing the drilled piece on the drill in the chuck, as shown in Fig. 3, and then so placing the dog on the work that the bars of the work are not at right angles to the hole as originally drilled, but at right angles to a hole that would be central if started at the same point as the original hole, and then drilling out this hole to the proper size, starting in at the original point and keeping the bars of the dog *square* with the lathe bed, the cross hole will be nearer central than when originally drilled. Fig. 3 shows the original hole off center to an exaggerated degree to show the principle.

Subsequently I used what I thought was a better way of drilling a hole crosswise through a round rod. Among my possessions, I have a rectangular cast-iron block, machined all over and having through it in its longest direction a hole that is a duplicate of the hole in the front end of my lathe spindle. This block, shown in Figs. 4 and 5, will take any of my draw chucks, which are drawn in it by a capstan nut at the back end. By fixing the work tightly in the chuck, and then resting the block on the surface plate on its side *a*, in Fig. 4, any piece that is machined square can be rubbed against the work; there will be burnished on the work a bright line that will be at the highest part when the block is turned quarter way over and rests on its side *b*. Now by clamping the block on to a parallel plate, as shown in Fig. 5, and making a center-punch mark on the bright line, the work may be drilled in a drill press with pretty good chances of its being central, provided quite a small drill is used first.

The latest device I have made for this sort of work is shown in use in Fig. 6, although this can only be used for drilling screw heads, and is not applicable to long rods, or even to short rods unless they have a shoulder turned on them. The fixture is made with a tongue on the back to fit the T-slots with the face plate of the bench lathe; but in order to eliminate any error due to the T-slots not being exactly central, the slots are numbered, and each end of the fixture is also numbered to correspond with the numbers of the slot in which it was placed during its original construction and its subsequent use.

The piece *A* is a gray-iron casting, while *B* is a sheet of unannealed sheet tool steel, screwed and doweled to *A*, the screws being countersunk. The V-shaped notch in *B* was first filed out approximately central, then put in place on *A*. *A* was so set on the face plate that the middle of the thickness of *B* was at the hight of the center. After this the slide rest was set to turn taper 15 degrees with the center line, and a small boring tool used as in boring a taper hole, taking a very light cut down the sides of the V-shaped notch in *B*. *B* was then unscrewed from *A* and placed on the table of the disk grinder, where the sides of the notch were carefully ground until the tool marks made by the boring tool just disappeared.

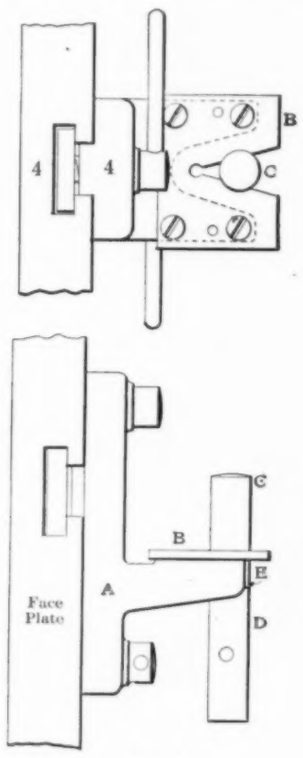


FIG. 6

In use, the fixture is clamped to the face plate of the lathe, with the upper face of *B* off center by an amount equal to the distance of the center of the handle bar from the shoulder of the screw. This can be determined near enough by placing a scale against *B* and reading it against the tail center. The screw *C* is placed in the V-notch, pushed back as far as it will go, and held there by nut *D* and washer *E*. A short, stubby, flat drill in

the tail spindle will now start a cross hole central, which can be finished to size with an ordinary twist drill without much danger of its running to one side or the other. The nuts *D* are double-ended, being tapped with a different thread in each end. Of the washers *E* there are two different thicknesses for each diameter of hole in the washers. They can be used either singly or in combination, giving in effect three different thicknesses of washers for various lengths of screw shanks. These washers are made of bessemer rod, case-hardened, while the nuts *D* are of soft bessemer rod.

Brooklyn, N. Y. WALTER GRIBBEN.

Slotting-machine Tool Bar with Frictionless Return

Having seen several slotting-machine tool bars described in back numbers of the AMERICAN MACHINIST, and having tried most of them, the one here described possesses distinct advantages over any other I have used, especially on heavy work where a frictionless return bar is most in need, to prevent the cutting edges of the tool being snapped off. We have used this bar on heavy locomotive- and marine-engine work for over two years, and find that it leaves nothing to be desired. One very excellent feature, not possessed by any other bar I am acquainted with, is that the cutting edge is practically flush with the bottom of the bolt or strap which secures the tool; therefore very little clearance is required between the cutting tool and the table, there being no screw heads projecting from the bottom of the bar.

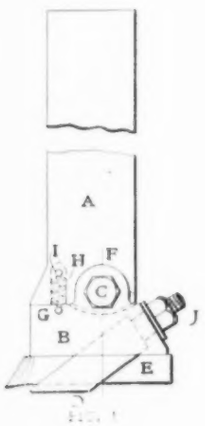


FIG. 1

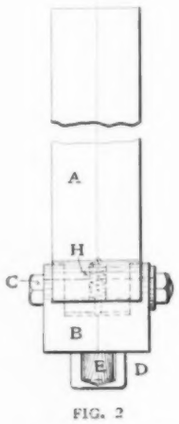


FIG. 2

SLOTTING-MACHINE TOOL BAR

A is a square steel bar. *B* is the steel swivel cutter block. *C* is the bolt for securing the two. *D* is the bolt or strap for securing the cutting tool *E*. The two lugs *F* are let into recesses in *A*, and take a portion of the pressure on the top, to relieve the strain on the bolt *C*, there being no shearing strain on the latter. *G*, shown in the side elevation, Fig. 1, is a ⅛-inch peg, for securing the bottom end of the spring *H* to *B*. The spring is dropped into a hole drilled in *A*, as shown, and secured by another peg *I*, at the top, shown also in Fig. 1. *J* is the nut for securing the cutting tool.

Fig. 2 shows the front elevation of the bar complete. Fig. 3 shows the side elevation of the swivel cutter block. Fig. 4 shows the end elevation. Figs. 5 and 6 show the bolt or strap for securing the cutting tool. The latter passes through an angular slot *K*, the bottom end of the bolt being beveled off at the same angle, to allow the cutter to get down close to the table—a very desirable and important feature in some cases.

England. J. GREEN.

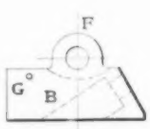


FIG. 3

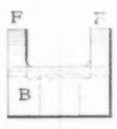


FIG. 4

FIG. 5

FIG. 6

Making Textile Rolls

On page 491 L. L. Arnold asks information and details about textile rolls. First, regarding the tool for cutting the slot for the ring, I use a common square file. I break off a portion of the tapered end, then heat the remainder and forge to the shape shown in Fig. 1. I then temper the tool, place it in the tool post and bore in to a depth of 2½ inches, not forgetting that the ring must be a tight fit on the inside. The ring is 12 to 14 inches inside diameter, 2½ inches wide and ¾ inch thick.

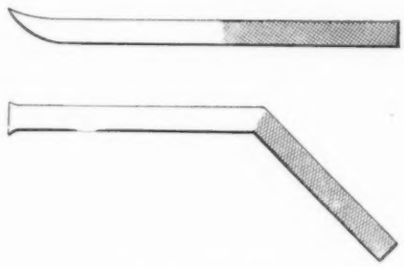


FIG. 1. THE TOOL

Next, to illustrate the method of counterboring the second end of the log with the shaft in place, Fig. 2 will explain this clearly. I use the same tool for counterboring for the spider as I use for the rings. The tool is bent so that the tool post will clear the shaft. From Mr. Arnold's sketch I think he is laboring under a wrong idea. He shows a shaft larger in the log than outside, while my shafts are the same size all through the log and spider and only barely trued up outside of the spider.

Regarding the size of hole for the shaft, I use a 37/16-inch spoon auger and drive a 37/16-inch cold rolled shaft through, using an old piece of 5-inch shaft 6 feet

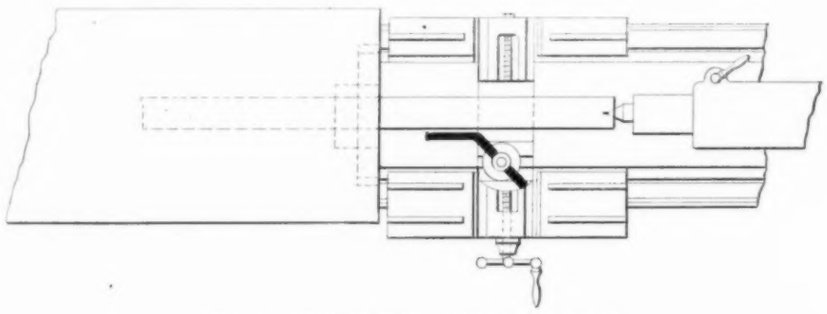


FIG. 2. COUNTERBORING SECOND END OF LOG

long suspended from the ceiling, as a battering ram.

While driving the shaft, one man holds a piece of brass against the shaft to prevent the end from being damaged. The spiders are a driving fit on the shaft. The spiders I use are 7 inches diameter and have a ¾-inch keyway in them. I cut the keyway in the shaft 3/16 inch deep, and up to the present have had no trouble. About making repairs, Mr. Arnold knows that when we are ready to put a new log on an old shaft the old log is of no use. We saw a 10-foot bowl (or log) into three sections with a large combination cross-cut and rip saw, taking care to not saw too close to the shaft; then we chop a portion of the end of the bowl away so as to get at the rings; next we drive off the rings and proceed to split open the bowl with heavy wedges until the shaft and spiders are laid bare. It is then a very easy matter to drive off one spider so as to be ready for a new log. I have never had a shaft come loose that we have made ourselves. But we have several rolls here, made by outside firms, that have given us trouble by coming loose on the end of the machine that draws in the cloth. This end of the machine has always the heaviest pull on the rollers. If Mr. Arnold wishes any more

information or does not see clearly into my explanation, I would be very pleased to have his address forwarded to me and I will cheerfully give, without any delay, whatever information I may have.

Newburg, N. Y. G. A. DEXTER.

Cam Levers for Small Tools

There are a great many uses to which the ordinary cam lever can be put on small tools in the shop, and, at the present time, I do not think many tool designers use them as much as they ought. While there are many different styles to suit different conditions, there are two or three styles that I have found occasion to use very frequently. These hold well and are quick acting. In the present day most companies want tools into which the work can be put almost instantaneously, and therefore it is up to the draftsman to get them what they want; hence the cam lever. I show three sketches of levers that I have used a great deal. The first, Fig. 1, is used for holding the swinging latch on a jig by putting the pin *A* through the top latch and swinging the lever from it. The hook *C* engages with a pin *B* driven into the jig casting.

The second style, Fig. 2, is used where two pieces are to be pulled together on a flat surface, or for clamping together two sliding jaws which hold the work between them. The third kind, Fig. 3, is used when a piece is clamped against a flat plate, the hole in the lever is set off the center and adjusted to suit the piece and held in place by a stud. I should not advise the use of this lever on rough castings unless they are very accurate to the pattern, as the throw of the lever should not be over 3/16 inch on a lever 2 inches in diameter at the head.

There can be almost any number of variations in the design of these cam levers, but, of course, they must be designed to suit conditions. I think anyone properly using them will be satisfied with the result and will do away with thumb screws and bolts, which at best are slow methods and cause profanity from piece workers.

Montreal, Can. P. S. SCHWIM.

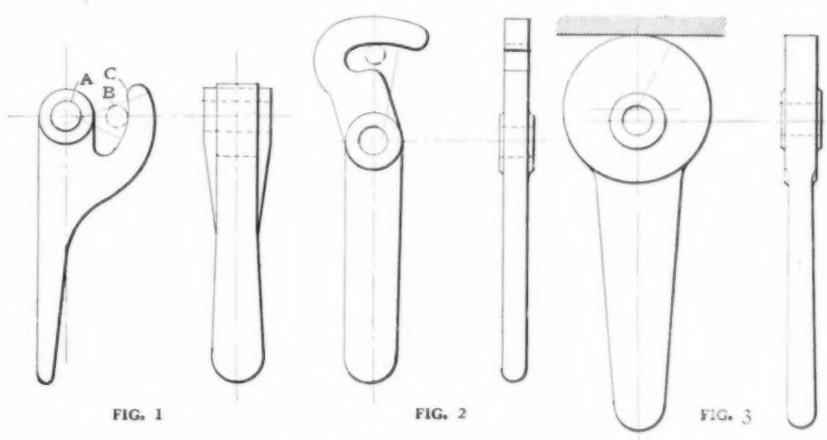


FIG. 1 FIG. 2 FIG. 3

TYPES OF CAM LEVERS FOR SMALL TOOLS

A Milling Fixture

The tool illustrated herewith is a fixture which has been found to possess decided advantages over other devices which have been designed to do its work.

In Fig. 1 is shown a piece of work in which the slots shown at *A* and *A'* are to be milled. It is very important in connection with this work that the slots shown be exactly 90 degrees apart.

Referring to the illustrations, *B*, in Fig. 3, is the base of the fixture and is of cast iron, *C* and *C'*, Fig. 3, are steel pieces which are fitted in the base of the fixture and secured by screws, as shown. They form projections which fit into a T-slot in the milling-machine table when the fixture is in position. At *D* and *D'*, Fig. 3, are partially shown the bolts which secured the fixture to the surface of the table of the milling machine. *E*, Fig. 3, is a machinery-steel spindle which has a long bearing in the fixture, as shown. The diameter designated by the letter *F* supports the work. The work is prevented from turning on this diameter by being forced against a shoulder, when the nut on the front of the spindle is tightened. At *G*, Fig. 3, is shown a pin, behind which is a spring. Normally the pin is in the position shown by the dotted lines *I*; but on placing the work on the spindle and clamping it against the shoulder, the pin is made to recede to the position shown by the full lines. Then by turning the set-screw *H*, shown most clearly in Fig. 2, the pin is clamped in a position where it will prevent the work from chattering when it is passed under the cutter.

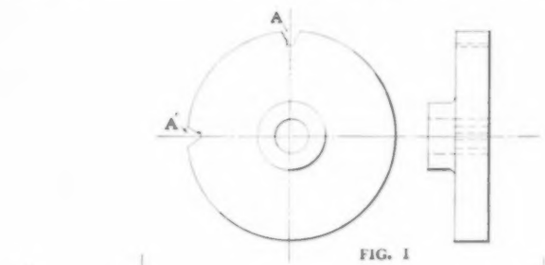


FIG. 1

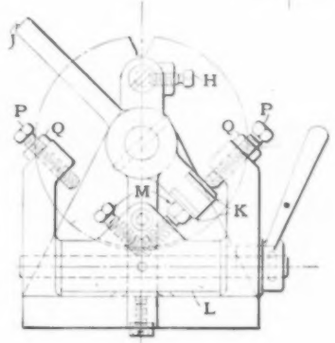


FIG. 2

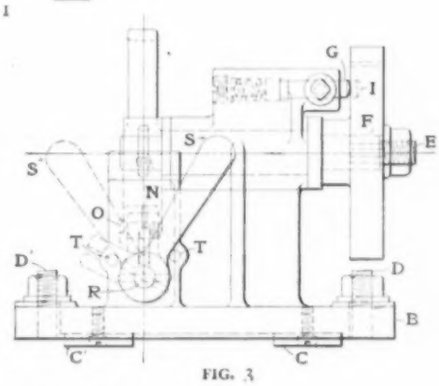


FIG. 3

A MILLING FIXTURE

On the rear end of the spindle is pinned a lever *J*, Fig. 2. On this lever, at *K*, are secured two steel plates, case-hardened, as they are continually in contact with the set-screws *P* and *M*. *L*, Fig. 2, is a cast-iron block carrying the set-screws *M*; the block is sawed into as shown at *N*, Fig. 3, and on tightening the screw *O*, Fig. 3, the set-screws *M* are clamped in whatever position they may be adjusted. At P_1, Fig. 2, are shown two set-screws, which are clamped by the check nuts *Q*. These set-screws are in the base, or main part, of the fixture. The block *L*, already referred to, pivots on the center *R*, Fig. 3, and receives a radial movement from connection with the lever *S*. The movement of this lever is limited by the pins *T*, Fig. 3.

In operating the fixture, the lever *J* is locked between the set-screws, as shown, and the set-screw *H* is released, allowing the spring pin at *G* to assume its

forward position. The work is placed upon the spindle and clamped against the shoulder, after which the set-screw *H* is tightened against the spring pin *G*. The work is now fed under the cutter, and one slot is milled. The work is drawn back, the lever *S* swung to the position shown by the dot and dash lines, where it stops against the pin *T* and the set-screw *H* is loosened.

It is now possible to index the spindle 90 degrees, the set-screws *P* and *M* being accurately adjusted for that angle. Accordingly, the lever *J* is swung 90 degrees, carrying the spindle and work with it, or more literally, causing the spindle and work to rotate 90 degrees. The lever *S* is now returned to the position shown by the full lines. It will be now observed that the lever *J* is locked in its new position. After tightening the set-screw *H*, the work is again passed under the cutter, and the second slot is milled, completing the operation.

The particular advantage of this fixture lies in the fact that by adjustment of the set-screws *P* and *M* all wear can be taken up. The indexing is absolutely positive. Fixtures which had been previously designed to do the work of the one described were not accurate in indexing, and poor work resulted. The arrangement shown at *G* for supporting the work against the cutter has proved itself to be a good feature also. Another good point about this milling fixture lies in the fact that it is quickly operated, wrenches being used only in clamping the work when placed on the spindle and in tightening and in loosening the set-screw *H*.

The fixture described is one which I recently had occasion to design. It is now completed and in use, and no fault is found with its work.

New Castle, Ind. T. DESSIN.

A Grinding Fixture for Ball Joints

Where very high speeds are used in running any machine it is always necessary to manufacture the different bearings with the greatest care in order to insure a long life to the machine. A machine having a reciprocating motion of about four thousand movements per minute was supplied with ball joints. These joints were case-hardened and lapped into bearing, which proved slow and often inaccurate. In order to overcome this difficulty, the fixture shown in the accompanying sketches was designed to grind them.

The fixture was fitted to a bench lathe. A chuck *A* having two arms which extended about three inches from its body, was made to fit on the screw of the lathe spindle. Holes perpendicular to the lathe spindle were made in the ends of the arms of the chuck.

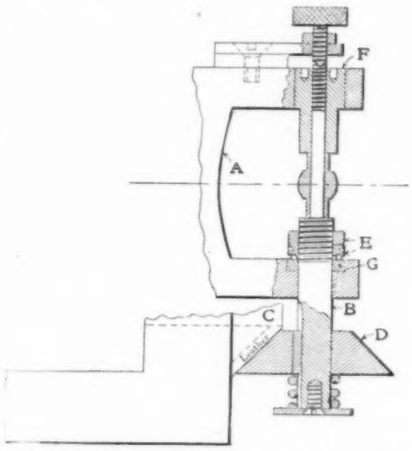
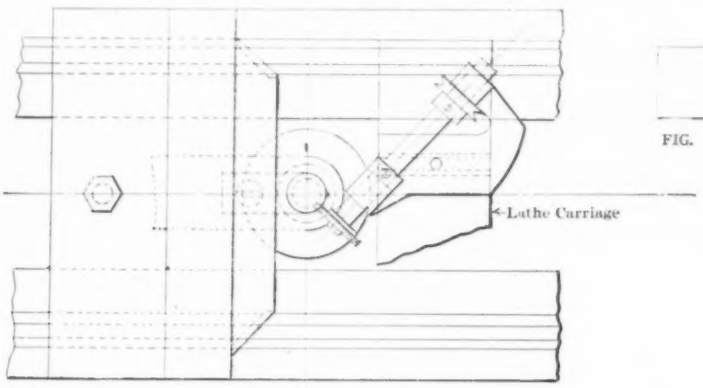


FIG. 2. LONGITUDINAL SECTION THROUGH THE SPINDLE



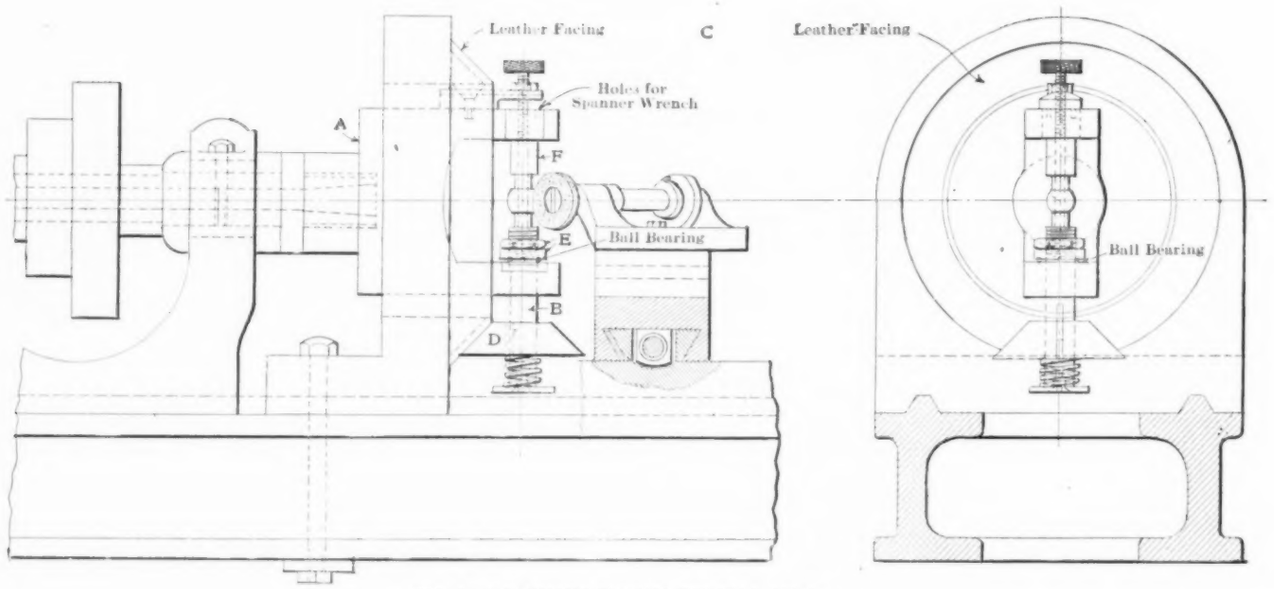


FIG. 1. A GRINDING FIXTURE FOR BALL JOINTS

A spindle *B* was made so that one end fitted one of the bearings in the arms, the other end being turned to the hole in the ball joint; two threads and a keyway were cut. When placed in its bearings,

the axis of this spindle exactly intersected that of the lathe.

The stationary friction wheel *C* was fastened to the lathe bed concentric with the lathe spindle. This friction wheel was necessarily covered with leather. The moving friction wheel *D* was fitted on one end of the fixture spindle. A key, which fitted the keyway loosely, was driven into the wheel *D*. This allowed the spring, acting against the outer side of the wheel, to maintain an even contact between the stationary and moving friction wheels.

The ball joint to be ground was placed on the fixture spindle by passing it through the hole in the arm of the chuck at the small end of the spindle, and was adjusted to a central position by the nuts *E*. One of these nuts which served as one of the bearings of the ball thrust bearing, was made of tool steel (hardened and drawn). The other side of the thrust bearing was made by driving a hardened and drawn tool-steel collar *G* into a hole counterbored in the arm of the chuck. The ball to be ground was held in place by the nut *F* which was screwed on the end of the spindle, acting also as a journal for the spindle. The thrust nut *E* is maintained in abutment by a nurled screw entering the small end of the spindle, the screw being held in place by a lock nut. The arm that holds the screw is made so that it can be swung to one side when the piece of work is being put on or taken off. The balls in the thrust bearing are necessary, owing to the friction produced by the spring acting on the moving friction wheel.

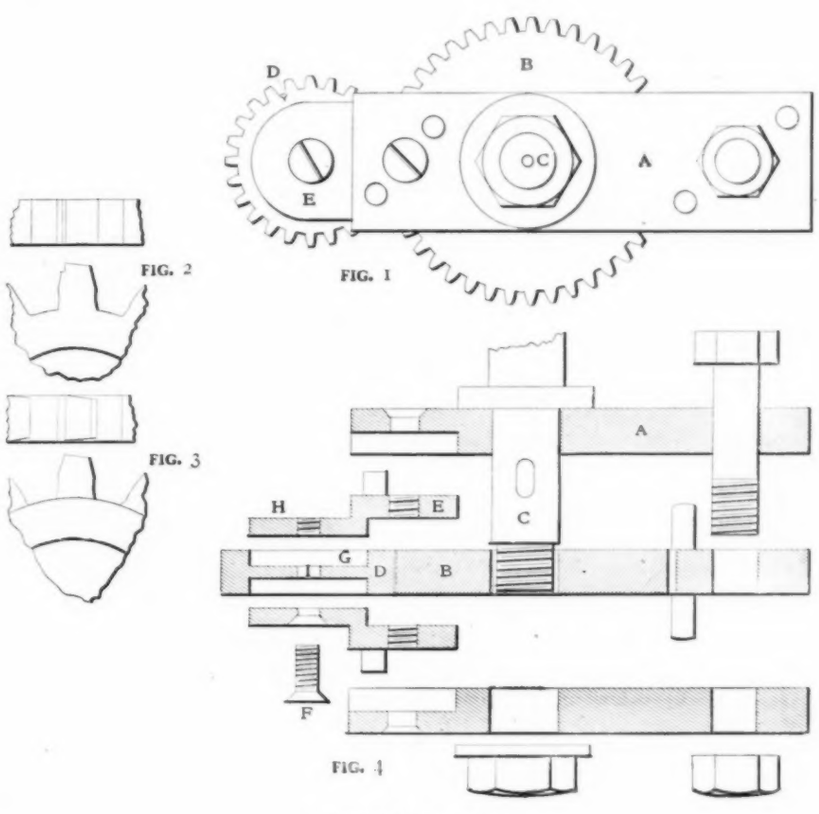
When the lathe was started, the chuck rotated the ball about one axis and the friction wheel rotated it about an axis at right angles to the first. The emery-wheel fixture was bolted to the tool-post slide; then by moving the emery wheel so that it touched one side close to the shoulder, the combination of the two rotations caused a complete zone of a sphere to pass in contact with the emery wheel.

This fixture was used for several different sizes of ball joints and always with excellent results.

Jersey City, N. J. W. A. RAYMUR.

A Slot-milling Fixture

The accompanying illustrations show a very handy and efficient fixture which, if it were more generally known, would be used very often on awkward and expensive milling and broaching operations.



A SLOT-MILLING FIXTURE

It will take a cut somewhat deeper than one-half the cutter diameter and has no arbor to be in the way when milling between uprights, etc.

It can be adapted to the milling machine, lathe, drill press, etc., or may be fitted up for a pulley drive. For milling close to a shoulder, between two walls, making cuts in deep and narrow recesses, milling slots and holes that would otherwise be broached, etc., it will often beat the small end mill, and it can be used in places where an end mill would be useless.

Fig. 1 is a side view of the fixture. *A* is the frame and must be held rigidly in order to support the cut. *B* is the driving gear keyed to the driving shaft *C*. *D* is the combination cutter and gear; it is cut with a regular involute cutter. It should be located in *A*, a little over the distance between centers that would be proper for gears running as usual. This is done to avoid breaking teeth off if chips should be carried around.

Figs. 2 and 3 show two ways of obtaining good cutting edges on the cutter. Fig. 2 is best if small cuts are to be taken and sizes must be maintained closely. Fig. 3 shows a very good way of relieving the teeth where heavy cuts are to be taken. These cutters must have a slight side clearance and are ground on the tops of the teeth also. They may be ground several times without interfering with their running well in *B*. *B* should be of tool steel and hardened.

Fig. 4 is a sectional view of the parts in position to assemble. A vital point is the fit of the recess *G* on the carrier *E*. The face *H* in *E* should be a little below the side of the teeth of the cutter *D*. The hole *I* in the cutter should be a little larger than the screw *F*, and *F* should be screwed up just enough to hold the carriers *E* to the side of the cutter without pinching it.

The fixture should be used under a stream of soda water, oil or air. Air is best in most cases.

I have seen this fixture used in some very trying places, and one who has not used it will be surprised at the quantity and quality of work it will turn out.

New Britain, Conn. B. S. FRANK.

Mechanical Engineers Meeting

The next monthly meeting of the American Society of Mechanical Engineers will be held Tuesday Evening, January 14, in Assembly Room No. 1, of the Engineering Societies building at 29 West Thirty-ninth street, New York.

The subject will be "Car Lighting," the presentation being made by R. M. Dixon, president of the Safety Car Heating and Lighting Company, and will treat of the general subject of light of trains, showing relative economies in the several systems, electric and gas, and promises to be of great interest.

The collapse of the Quebec cantilever bridge draws attention to the really remarkable size of this structure. When completed it will be the longest single span in the world, being 675 feet long, or 90 feet more than that of the great cantilever bridge over the Firth of Forth, Scotland, which up to now has been known as the longest span.

AMERICAN MACHINIST

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Jan. 2..... 37,500

This paper reaches 37,500 *separate readers each month and* 20,000 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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The Omission of Claims from the Patent Office Gazette

Some of our readers are aware, and others ought to be, of a recent spasm of economy in the printing of the Patent Office *Gazette*, by which that publication is made well-nigh valueless for its intended purpose. The issue of November 19 contains the following notice.

"Beginning with this date and number of the *Official Gazette* all patents having five claims or less are printed in full. Where patents have more than five claims each only five claims are printed, and the number of claims omitted is indicated in each case. This plan will be followed in each succeeding number of the *Gazette*. All the specifications and claims will be printed in the patents and library edition in large type."

Glancing through the magazine we find that this new policy has been carried out, the claims given being followed by such statements as "Claim 6 to 45 not printed in the *Gazette*;" the figures in other cases running 6 to 23, 6 to 29, 6 to 32, 6 to 68, 6 to 61, and no doubt still more striking cases exist.

With the increasing minuteness in differentiating claims when drawing patents, the number of claims has largely increased in recent years, the number, in many cases, being such that the first five do not disclose the invention in any useful manner; the result being that the *Gazette* now fails entirely of its purpose in keeping manufacturers informed regarding the claims of their rivals. Moreover, the new procedure opens the door to an obvious line of manipulation by which a solicitor may so arrange his claims that the really important ones are not included in the first five, with the result that the invention is not properly disclosed in the *Gazette*, and where this practice is not followed the suspicion that it may have been throws such doubt upon the claims printed as to make them practically valueless.

Of course, it frequently happens that but one, or only a few of the claims in a given patent are involved in interference or infringement proceedings, and if these particular claims do not happen to be included in the first five, the general public has practically no means of knowing of their existence. While, of course, many manufacturers have copies of the patents issued in their line sent to them regularly, they nevertheless still depend upon the *Gazette* to keep them informed regarding the general character of the patents issued, and this, especially under the possibilities of manipulations pointed out above, it now fails to do. The publication has, in fact, become little more than an index of patents, and a cumbersome one at that, because it does contain these five claims, which in many cases might as well be omitted with the others unless all are published.

The patent office is one of the few, and perhaps the only, bureau connected with the National Government which is regularly operated at a profit. The office has now to its credit a balance of over six millions of dollars, which has frequently been called attention to in connection with the parsimonious policy of the Government in providing facilities for it. No one can doubt the justice of the claim of the office for additional facilities, and still less can he doubt the absence of justice in thus curtailing, and practically destroying, the usefulness of one of the adjuncts of the office. This would seem to be a case justifying action by the National and other associations of manufacturers in order to restore the usefulness of what has come to be a very important publication to manufacturing interests.

With the growth of the *Gazette* in size there could be no objection to an increase in its price, especially as those who take it are well able to pay what it is worth. From no possible standpoint can the destruction of its usefulness be justified.

Proposed Investigation of Steel and Structural Members to be Conducted by the Watertown Arsenal

An increased appropriation has been made available for the current fiscal year for the extension of the work carried on in the past at the Watertown arsenal in the investigation of the properties of materials of construction. It is proposed to conduct this investigation along lines of the greatest practical value to users as well as manufacturers of materials. In the experimental study of steel and steel products it is proposed to begin with the metal in the ingot and thence to follow it out to the finished sections and to built members.

By authority of the Ordnance Department, William R. Webster, consulting engineer, and Edgar Marburg, professor of civil engineering at the University of Pennsylvania, have been engaged to cooperate in the preparation of the program of tests, and in the prosecution of the work. A meeting attended, at their invitation, by about twenty-five consulting engineers and representatives of leading consuming and manufacturing interests was recently held at the Engineers' Club, New York City, for the purpose of meeting Major C. L. H. Ruggles, commanding officer, Watertown arsenal, and J. E. Howard, in charge of the Watertown testing laboratory, with a view of determining the most desirable program for the initiation of the proposed investigation. This meeting was held in two sessions.

One session, presided over by Dr. Charles B. Dudley, chemist, Pennsylvania Railroad, was devoted to a discussion of metallurgical questions applying to ingot

structure, blooms, billets, slabs and forgings, and it was the sense of the meeting that it was desirable to make a study of these questions a special feature of the proposed work.

The second session, at which J. V. W. Reynders, vice-president Pennsylvania Steel Company, presided, was devoted to the consideration of a preliminary program for tests of structural members, including columns, riveted tension members, riveted splices, riveted connections in building construction and the general subject of riveting.

At the opening of the meeting Major C. L. H. Ruggles, commanding officer, U. S. Watertown Arsenal, explained that the work was not to be regarded in any sense a Government investigation of steel, but that it was the desire of the Ordnance Department to utilize the increased appropriation with a view not only to the needs of the Government, but also to making the results as valuable as possible to all persons interested in the subject of steel, whether as consulting engineers or as representatives of consuming or manufacturing interests.

J. E. Howard, in charge of the testing laboratory at Watertown arsenal, presented in abstract his report to the Ordnance Department in which attention was drawn to the desirability of making provision for the extension of the usefulness of the testing laboratory, and indicating in detail numerous lines of research that might be taken up to advantage.

It was the sense of the meeting that the extension of the testing facilities in this country had not kept pace with the advance in engineering construction, and a resolution was adopted by unanimous vote that the enlargement of the present facilities at the U. S. Watertown arsenal by the erection of a testing machine of at least 10,000,000 pounds capacity was desirable. It was also decided to authorize the chairman, Dr. Charles B. Dudley, to appoint two committees, subject to the approval of the Watertown authorities, one on ingot structure, billets, blooms, slabs and forgings, and the other on tests of structural materials. These committees have since been appointed and much preliminary work has already been accomplished, which will be submitted at an early date to the engineering profession for criticism and suggestions.

New Publications

ENGINEERING WORK-SHOP PRACTICE. By Chas. C. Allen. 254 5x7-in. pages, with 152 illustrations. Price $1.50.

By a typographical error in our notice on page 567 we were made to give the name of the author of this book as Chas. G. Dolan. We should also add that the American publishers of the book are E. P. Dutton & Co., of this city.

We cannot refrain from making note of a special issue of *Cassier's Magazine* for November, which is devoted to gas power and contains a series of striking articles. The number opens with a review of internal-combustion engines by the editor, which is followed by articles giving the practice of Germany, England and this country in the building of large gas engines. The utilization of waste furnace gases; the blast furnace as a center of power production; by-product recovery gas-producer plants; the utilization of low-grade fuels in the gas producer; and other special articles make up an issue that no engineer can afford to miss.

NOTES OF THE CONSTRUCTION AND WORKING OF PUMPS. By E. C. R. Marks. Second Edition. 259 5x7-inch pages, with 159 illustrations. The Technical Publishing Company, Ltd., London; The D. Van Nostrand Company, New York. Price 4s. 6d., $1.50.

This volume is intended for users rather than for makers or students of pumping machinery. It is largely descriptive. and includes nearly all types and classes of pumps, including modern turbine and air-lift pumps. In addition to the descriptive matter considerable information regarding the sizes and arrangements of pipes, air chambers and other connections, is given.

MODERN STEAM TRAPS (ENGLISH AND AMERICAN). By Gordon Stuart. 104 5x7-inch pages, with 71 illustrations. The Technical Publishing Company, Ltd., London; The D. VanNostrand Company, New York. Price 3s., $1.25.

There is, so far as we know, no source from which information can be obtained regarding the construction and operation of the numerous types of steam traps which are on the market and to those who are engaged in steam heating and other lines of work involving the use of traps, Mr. Stuart's little book will be welcome. The American reader will find many traps described with which he is already familiar, so far as external appearance goes, together with others which are new to him. The various makes are classified in accordance with their principle of construction, and their operation is made clear by numerous illustrations and descriptive text.

THE BLACKSMITH'S GUIDE. By J. F. Sallows. 160 pages, 4½x7 inches, 165 illustrations. The Technical Press, Brattleboro, Vt. Price, $1.50 in cloth, $2 in leather.

We believe this is the first book to deal with machine blacksmithing from the standpoint of the workman and not of the technical student, but there is no reason why the latter should not use it with equal advantage. It is written by a blacksmith of 27 years' standing, who is making good in practical every-day work with various kinds of iron and steel. The chapters include Machine Forgings; Tool Forging; Hardening and Tempering; High Speed Steel; Case-hardening and Coloring; Brazing and General Blacksmithing, together with a table of decimal equivalents and color charts for heating and hardening, together with working drawings of a furnace for case-hardening. The author believes in so heating and cooling a tool that the body will be soft and the cutting edges hard without drawing the temper as is the usual practice. It is handy for the pocket and blacksmiths, machinists and toolmakers should find it very helpful in their work.

Personal

John Astrom, formerly associated with the Nordberg Manufacturing Company, has severed his connection with the company and for the immediate future will give his attention to private experimental work.

I. McC. Bean, who has been with the Packard Motor Car Company, New York City, has recently joined the forces of the Northwestern Iron Company, Mayville, Wis., to act in the capacity of assistant manager.

William Chase, recently connected with the engineering department of the National Cash Register Company, of Dayton, Ohio, has accepted a position as mechanical engineer with the Cleveland Twist Drill Company.

K. O. Truell, who has been on the engineering staff of W. S. Barstow & Co. New York City, has taken charge for the Fordwich company of a new conveyer installation at the plant of the Virginia Portland Cement Company.

H. F. Sanville, for the past two years with the engineering firm of Dodge & Day, Philadelphia, and for four years secretary of the Philadelphia section of the American Institute of Electrical Engineers, will join the organization of Frank B. Gilbreth, New York City, on the first of the year.

Charles F. Smith, author of the noteworthy articles on the the lay-out and construction of cams, which appeared in our columns in the early part of 1905, and subsequently published in book form, has opened an office for the design of automatic machinery at 141 Varick street, New York City.

A. H. Briggs, for many years manager of the New York office of the L. S. Starrett Company, having formerly been connected with the Frasse Company of New York City, announces the establishment of his own business at 136 Liberty street, New York. Mr. Briggs will represent manufacturers of high-grade tools.

*Items for this column are solicited.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

New Electric Hoist

The illustrations show a number of different applications of the new Shepard electric hoist recently put on the market by the General Pneumatic Tool Company, Montour Falls, N. Y. As will be seen in Fig. 1, the general design is very compact, embodying the motor at one end in direct line with the hoisting mechanism and the rope drum, while at the back is a controller of ample size and with an unusual number of resistance steps so as to afford the most delicate control. This also greatly increases the life of the motor, which is seriously affected by throwing on the full voltage, as is sometimes done.

The compact design allows a very substantial construction in every way, so as to withstand the rough usage due to unskilled labor, and should greatly reduce the repair bills.

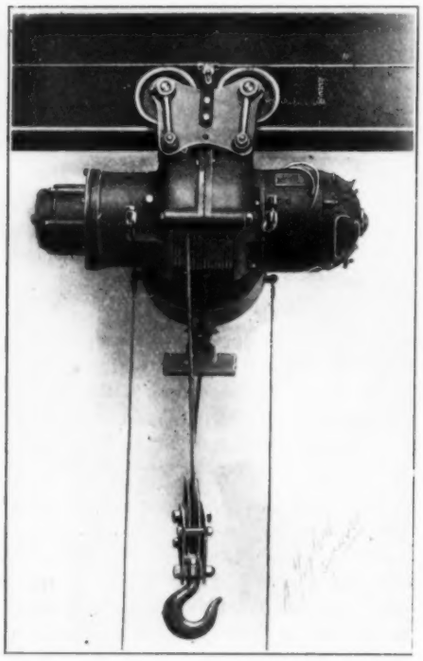


FIG. 1. THE SHEPARD ELECTRIC HOIST

A feature which will interest the users of Shepard traveling cranes is that the parts of these hoists are made interchangeable with similar parts of their standard cranes, so that a minimum supply of duplicate parts will insure constant operation at all times.

Careful attention has been paid toward making these hoists accessible, and as a result each important group of parts is easy to get at without interfering with any other portion. Should it become necessary to remove the armature of the motor, no part of the electric wiring need be disconnected, except the armature leads, and no part of the hoisting mechanism needs to be removed except the front housing of the motor itself. A similar provision is made for convenient access to all the important parts, both for removal and replacement. None of these operations requires special wrenches or tools of any kind.

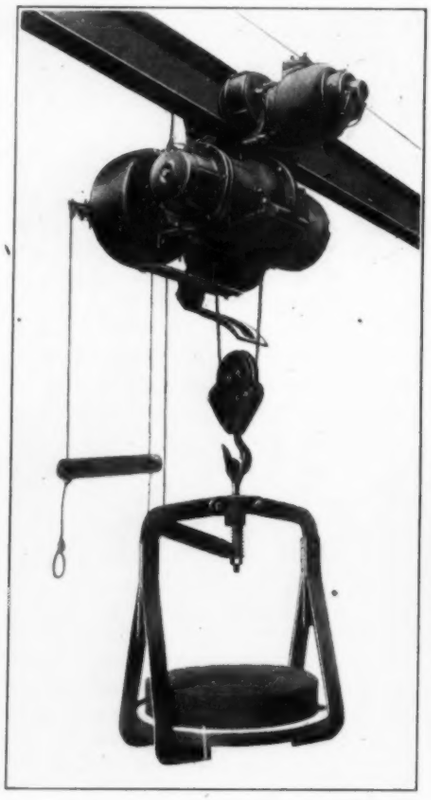


FIG. 2. TRAVELING HOIST USED BY THE NORTON COMPANY

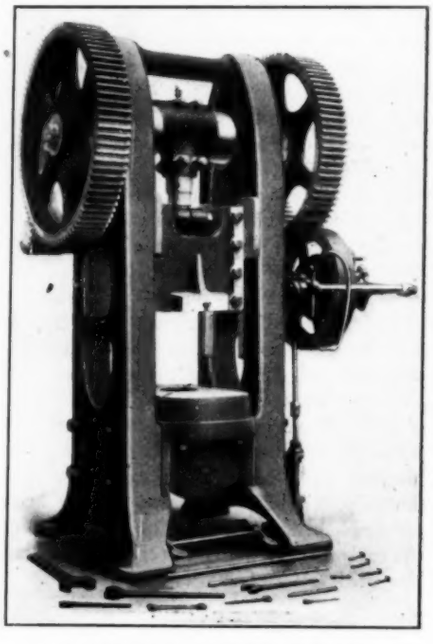
Another feature is that no provision is made for adjustment, which does away with all tampering, and the hoists are designed with a sufficient margin of safety so that any natural wear will have no effect on their operation. The lubrication has been provided for with the same care, and all that needs to be done is to fill the three oil reservoirs, which are in conspicuous places, before they become empty. These hold oil enough for a long period and insure the hoist against undue wear from the parts becoming dry and cutting or overheating.

Fig. 2 shows a hoist fitted with two motors, one for hoisting and the other for its travel along the overhead beam. This hoist is in use at the works of the Norton Company, Worcester, and as it shows, is carrying an unbaked emery wheel on the way to the kiln.

These hoists are occasionally provided with cages so as to travel under the control of an operator in the same way as the long span traveling crane. One of this type is in use at the new plant of the American La France Fire Engine Company, Elmira, N. Y.

A New Ferracute Single-crank Press

The accompanying illustration shows a large single-crank press recently built by the Ferracute Machine Company. It is particularly adapted, when made with a long stroke, for cold drawing heavy sheet steel, for producing seamless shells, automobile hubs, ball-bearing cups and similar work. When built with a shorter stroke, it is adapted for blanking, trimming, shearing and embossing.



FERRACUTE SINGLE-CRANK PRESS

One feature of the design is the wide-faced twin gears which are cut from the solid. They tend to relieve the torsional stress on the shaft and to produce a very even pressure, as the load is divided between them. The back shaft with its pin-

ions is made from a single steel forging. The main shaft is forged from high-carbon steel, and the pitman stem is also of steel. The friction clutch is of the multi-disk type, and the automatic stop can be quickly adjusted so that the ram can be stopped by hand at any point of its descent or ascent, or if desired it can be set for continuous running. The press is arranged for the use of positive knock-outs provided they are desired.

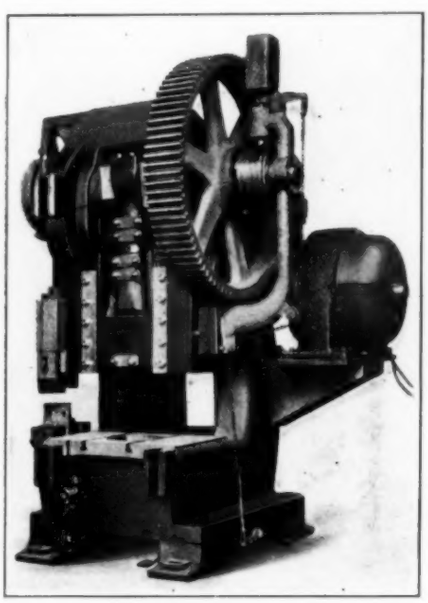
The makers' designation for this machine is press DGG—121. It has a distance between uprights of 28 inches, and the stroke can be varied between 3 inches and 17 inches. The finished machine weighs about 25,000 pounds and is estimated to exert a pressure of 200 tons.

Large Open Back Power Press

The machine shown is supposed to be the largest open back, single pitman, gap power press in existence, weighing 35,000 pounds and standing about 10 feet high.

It is designed for trimming forgings either hot or cold in one of the United States Navy Yards, in connection with heavy blanking work and shearing. For this latter work the outer slide at the left will shear bars up to 3 inches square.

This has a 3-inch movement, while the inside or main slide has a stroke of 7 inches to allow the trimming of forgings of irregular or special shapes. The motor is 20 horse-power direct connected to the pinion which drives the clutch gear. This is 62 inches in diameter and has a 10-inch face. There is also a balance wheel, not shown, which weighs 1600 pounds.



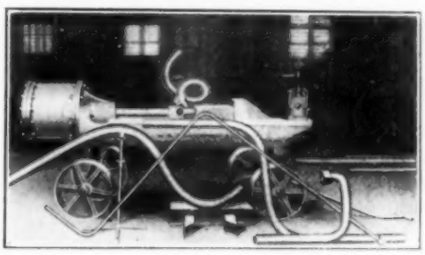
LARGE OPEN BACK POWER PRESS

The distance between uprights is 27 inches, from bed to slide 20 inches and from the slide center to the back of gap, 16½ inches.

This is the largest of the line built by the Toledo Machine & Tool Company, Toledo, Ohio.

A Pipe-bending Machine

The illustration shows a pipe-bending machine having a pneumatic cylinder which takes its supply of air from the usual shop system.



A PIPE-BENDING MACHINE

Dies of standard radius are supplied for locomotive work for pipes from ½ inch to 2 inches. Special dies of any size or shape are made to order.

A right-angle bend in a 2-inch pipe can be made in two minutes.

This machine is made by H. B. Underwood & Co., Philadelphia, Penn.

Combination Disk Grinder

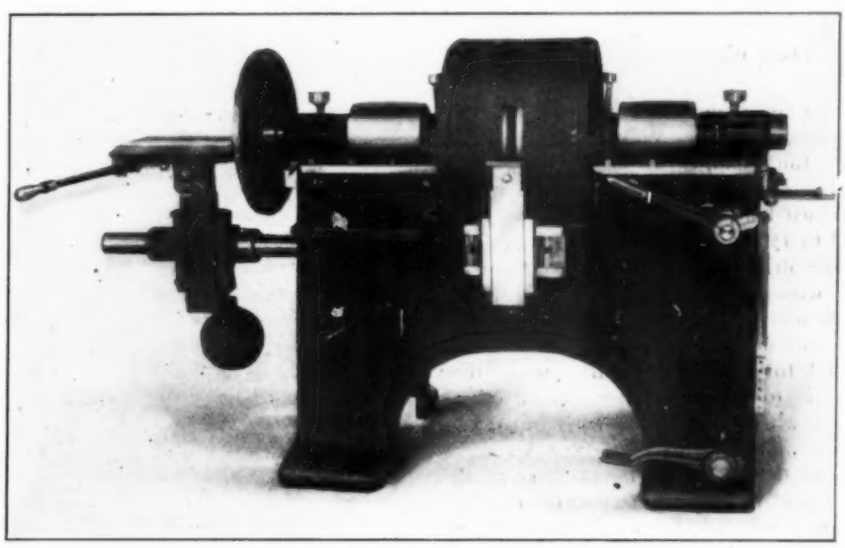
The disk grinder shown in the accompanying illustration is somewhat different from the usual machine of this class in general design as well as being an extremely large machine as is indicated by the eight-inch belt used for driving it.

This is a combination of a single- and double-head disk grinder and consists of two heads which can be moved independently in the slide shown. The hood or casing in the center completely incloses the double wheel and in some ways obscures the construction, but this can be thrown back to allow free access to the wheel when necessary. This hood is also provided with an opening at the back for connecting an exhaust fan. It is fitted with shields in front which can be made of any size to accommodate the work in hand and when suitably connected to an exhaust fan it is entirely free from dust. A somewhat similar hood is provided for the single wheel at the left, but is not shown in the illustration.

The left-hand head carries two wheels, one of them being inclosed under the hood and forming one of the wheels for double surface work having opposite parallel sides such as washers, nuts, wrenches, etc. For work of this class, 20-inch diameter wheels are used, while the disk at the left can be as large as 23 inches, if desired. The left-hand wheel has an adjustment of 8 inches and is supplied with what is called a universal lever table, which is especially adapted for a large variety of grinding operations. This has quite a number of different adjustments as shown, but any style of work table can be used. Micrometer stop screws are provided for all adjustments and feeds so that duplicate or interchangeable work can be easily produced.

In double face work the right-hand disk is normally held away from the work by the spring shown, but can be moved to its grinding position by either the hand lever or the foot pedal. When the latter is used it allows the operator free use of both hands. The construction is necessarily powerful and rigid and the end thrust of the spindle is taken on large hardened steel collars which bear on rings of combination of cast iron and babbitt.

The grinder is furnished with the usual setting-up press for cementing the emery circles to the disk, if preferred, a special chuck for ring emery wheels can be supplied in place of the disk. This is sup-

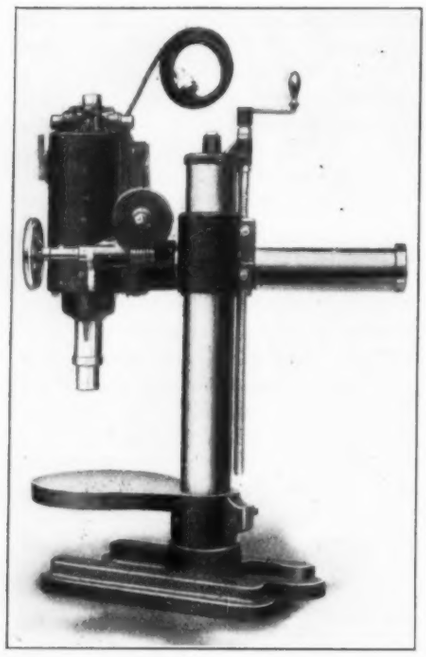


LARGE COMBINATION DISK GRINDER

posed to be one of the largest and heaviest disk grinders ever built and is the product of the Gardner Machine Company, Beloit, Wisconsin.

Large Portable Electric Drill

Ever since the introduction of the portable electric drill, sizes have been steadily increasing and this is probably the



LARGE PORTABLE ELECTRIC DRILL

largest yet produced. It is known by the builders, the Hisey-Wolf Machine Company, Cincinnati, O., as the Electric Scotch Radial, and the large size will drill up to a 2-inch hole, the other sizes being limited to 1¼ and ⅞ inch respectively.

The drill has a 12-inch feed through the worm and gear on the hand-wheel shaft and a quick return. The feeding mechanism can be adjusted from a horizontal to a vertical position when the drill is to be used in corners or other places where space is limited.

The motor has two speeds, under control of the hand by a thumb lever at all times and in spite of the size, the driving power is obtained from an ordinary lamp socket by the usual flexible cord. The motors are made either for direct or alternating current, as may be desired.

Both the horizontal and vertical columns are made from steel tubing, provision being made for raising and lowering the drill head by the screw shown and all horizontal adjustment being taken care of by the rack shown on this arm. The head also swings at any angle so that the operator has complete control of the drill, up and down the column, and with the swinging table can drill to the center of a 24-inch circle and at any angle desired.

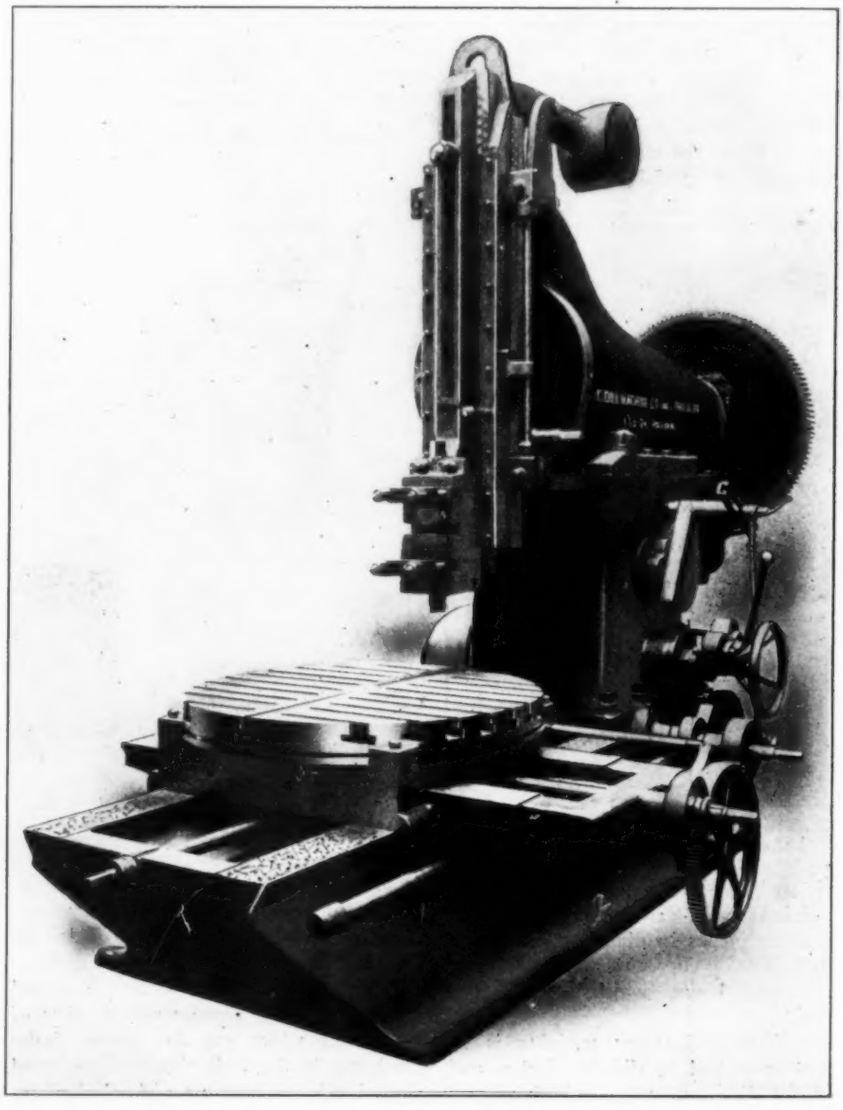
The use of portable tools is growing every day and there are few shops that cannot use a drill of this kind to advantage.

A Right-angle Drive Slotter

The accompanying half-tone shows a 20-24-inch slotter arranged with a right-angle drive. The receiving-cone pulley, it will be noted, is opposite to the working side of the machine and on the other end of the power quick-traverse shaft, which is right angle from the usual cone-pulley shaft. This makes a very neat arrangement of the right-angle drive in a slotter.

The advantages of a right-angle drive for a large slotter are very apparent when one considers that the line shaft usually runs lengthwise with the shop and that it is very convenient to have a slotting machine set crosswise with the same in order that the upper portion of the machine may not be in the way and yet can readily be supplied with heavy work by the traveling-crane service.

This slotter is made by the T. C. Dill Machine Company, Inc., of Philadelphia, Penn.



RIGHT-ANGLE DRIVE SLOTTER

Individual Efficiency in Hard Times

By Entropy

Every little while there appear signs of hard times ahead. Sometimes they prove to be true, but oftener false. However, they turn out to be right often enough so that it behooves us all to be on our guard and keep in a position to stand off the wolf. How can a man prepare for hard times? Of course he can save money, but even that is apt to be tied up so that he does not want to touch it when money is scarce. If he owns a house, it represents his savings; but when business is dull is the worst time to sell. Stocks or bonds

are worse yet. What we all want is employment. If the price of roast beef, rent and all the things we buy drops to one-half what it is now, we will be just as well off on one-half pay; but we must hold our jobs. Now, how can we hold our places? I have talked with many business men and, for that matter, I have hired quite a few workmen at one time or another, and here is an average of what employers think.

They all agree that they will make very great efforts to keep their best men, even if they lose money by so doing. They agree, too, that their best men only constitute from 10 to 20 per cent. of their force. This is with the exception of a few firms doing extra-fine work, who are very anxious to hold their entire force together. I may safely say that, if your employer considers that you are one of his best men, he will lose money rather than lose you. Now what will make your employer consider you one of his best men? Will it be because you can always work close to measurements? Will it be because you do your work quickly? These are two things that one would naturally think of, but I believe that they take second place in a good many employers' minds. The thing that your employer is going to think of first of all is, "Who can I depend upon? Who is here every day? Who is here on time? Who will stay and finish an emergency job without growling? Who can be depended upon to stop his mate's lathe if it is going to run up against a shoulder and spoil something? Who can be depended upon to go out on a job and come back when he should, and sober? Who will take a job that must be right, and get it right without any chance of a second try?"

I am thinking just now of a man that I have known for 20 years or more, during more than half of which he worked for me. He has been through all of the hard times for the past 50 years, and he tells me that he never lost more than a day at a time for lack of work. He is not what you could call a fine workman, nor is he ordinarily very quick; but you can depend on him every time to rise to the occasion. If you have a repair job on a shaft, and it is wanted in less time than you think it can be done, give it to him; he will get it done. Watch him work. He goes at it with confidence, but with care. His mind is on that job and on nothing else. While his lathe is running up a cut, he is getting his straightener alongside, where he can get it on the lathe in a hurry. Every move is effective. When the job is over, if it is half an hour before quitting time, he goes back at his old job without a word. Does he get imposed upon by having the boss pretend the job is in a hurry? No! He knows and the boss knows that every shop in town would like to get him. He knows enough to stay where he is well used and where the job is steady, and the boss knows enough to save him for emergencies. Does he get the top price? No! I never knew him to get all that he could have gotten by holding out for it, when business was good, but I have known of his being the only man in the shop that did not get a cut when business went down.

Now, if this chap were only an educated man, my story would be complete, for I could point out that by diligent study a young man could achieve independence. This man is educated only in the sense that every man who thinks about his work educates himself. He never had a start in schooling, and I doubt if he could hold his own in figures with a boy from the fifth or sixth grade. He is just a simon-pure machinist, like lots of readers of the AMERICAN MACHINIST. He gets his hold on his employers just because he is ready, willing and able to do what is wanted in a machine shop. He has hard times nailed down where I believe he makes more money than when times are flush.

I can imagine someone reading this and saying; If we are all so diligent then there will have to be just as many men dropped anyway, and we will suffer just the same, so let's take things easy. Don't for a moment believe that everybody is going to take this advice. For one thing, there are enough machinists that do not read the AMERICAN MACHINIST, and who have no ambitions beyond pay day and a keg of beer, to furnish all the men necessary to be fired. There will always be plenty of such. If times turn dull, there will be some foremen who will go to other shops as machinists; there will be leading machinists that will take jobs on coarse work; there will be poorer machinists that will become helpers and so on, until the helpers are the ones that are crowded out. I have never known of times so dull that a really good man, one who used his brains, could not get a living. To be sure, shops often suspend business through no fault of their workmen; but their really valuable men are snapped up by other concerns. If you are thrown out of a job, and cannot get one, look yourself over and see if you can tell the reason why. It lies with you and you only.

Business Items

The Bristol Company, Waterbury, Conn., has been awarded a silver medal by the Jamestown Exposition for its recording electrical instruments and pressure gages.

The Foos Gas Engine Company, of Springfield, Ohio, has purchased the business of the Marinette Gas Engine Company, which comprises the line of Wairath multiple cylinder engines for electric and power work.

The Ingle Machine Company, Rochester, N. Y., moved from Mill street to their new building, 299 to 309 St. Paul street. The new shop has an area of over 30,000 feet, and is completely equipped for handling all kinds of machinery work.

The Geo. Nash Company, which has an extensive warehouse in New York, has erected a large one at 115 Washington Boulevard, Chicago, Ill., where it will carry a full stock of crucible cast steel, "Capital" high speed steel, and other brands, ready for delivery in any sizes, lengths or quantity, as well as a full line of Capital high speed drills, etc.

Trade Catalogs

Dreses Machine Tool Company, Cincinnati, Ohio. Loose-leaf catalogs of radial drills and screw and turret machinery. Illustrated.

Lehigh Car, Wheel & Axle Works, Fullerton, Penn. Catalog of Fuller-Lehigh pulverizer mill. Illustrated, 44 pages, 9x12 inches, paper.

The Dean Gas Engine and Foundry Company, Newport, Ky. Catalog of Dean engines for gas, gasolene, alcohol. Illustrated, 40 pages, 6x9 inches, paper.

General Electric Company, Schenectady, N. Y. Bulletin No. 4550, describing carbon-break circuit breakers, type C, forms G, P and K. Illustrated, 36 pages, 8x10½ inches. Bulletin No. 4551, illustrating and describing Thomson horizontal edgewise instruments. 16 pages, 8x10½ inches.

Manufacturers

The Benson Lumber Company, San Diego, Cal., will erect a box factory.

The Portsmouth (Ohio) Steel Company is erecting a new machine shop.

The Monarch Electric and Wire Company, Chicago, Ill., will erect a new plant.

The Consumers Ice Company, Chester, Pa., is building a new plant to replace the one burned.

The Oesterlein Machine Company, Cincinnati, Ohio, proposes to erect an addition to its plant.

It is stated that Keough & Trotter, Chatham, Ont., will erect a machine shop addition to their plant.

The Cummer-Diggins Company, Cadillac, Mich., will rebuild saw-mill and lumber plant recently burned.

The King Stove and Range Company, Sheffield, Ala., will rebuild the foundry recently destroyed by fire.

The Ireland & Matthews Manufacturing Company, sheet metal goods, Detroit, Mich., will build a new factory.

The Soo Line will build an addition to its machine shop in Minneapolis, Minn., which will cost $60,000, it is said.

Fire destroyed the plant of the J. L. Means Machinery Company, Shreveport, La., causing a loss of about $40,000.

The C. Raymond Company, Dayton, Ohio, is asking for bids for the construction of a foundry building to cost $100,000.

The Detroit (Mich) Machinery Company will move to Monroe, Mich. The company manufactures paper box machinery.

The Rockmart Stove Manufacturing Company, Rockmart, Ga., contemplates establishing a stove foundry in Selma, Ala.

The Fayetteville (N. C.) Woodenware Company will rebuild plant recently destroyed by fire, to cost about $10,000.

The Wells-Fargo Express Company, Kansas City, Mo., contemplates building repair shops. R. A. Wells is general manager.

The British Columbia Electric Railway Company will erect additions to its car shops in Victoria, B. C., to cost about $10,000.

The Excelsior Stove and Manufacturing Company, Quincy, Ill., contemplates putting up a six-story addition at a cost of $50,000.

The Triumph Electric Company, Cincinnati, Ohio, has bought a site in Oakley on which several factory buildings will be erected.

The United Drop Forging Company, of West Springfield, Mass., whose plant was destroyed by fire some time ago, is planning to rebuild.

The Severance-Broughton Company, Walla Walla, Wash., is planning to erect a new machine shop for which new machinery will be needed.

The R. L. Beasley Steam Stump Puller Company, Gordon, Ala., contemplates expending about $50,000 for buildings and machinery.

The Progressive Stove and Furnace Company, Colorado City, Colo., will build an additional molding room and an extension to the machine shop.

The American Case and Register Company, Alliance, Ohio, will erect a factory building at Salem, which will contain 50,000 square feet of floor space.

An extension is being built to the machine shops of the Butte, Anaconda & Pacific Railroad at Anaconda, Mont., which will double the capacity.

The plant of the Westwood Turning Company, Fremont, Ohio, was burned. Loss $10,000. The company manufactured neck-yokes, single-trees, etc.

The Harrisburg (Ark.) Hardwood Lumber and Handle Company, recently organized, will establish a planing mill and handle factory. J. A. Davis is manager.

The Southern Railway Company has awarded contract for the rebuilding of coal chute at Pelham, N. C., recently burned, to cost $50,000, it is said.

The J. I. Case Threshing Machine Company will build a new repair plant and warehouse at Fargo, N. D., to replace the one recently destroyed by fire.

The Oklahoma Carriage Company, Oklahoma City, Okla., will erect factory for manufacturing transfer and livery equipment at a cost of $20,000.

Contract has been let for the construction of the new railroad shops for the Intercolonial Railway at Riviere Du Loup, Que. F. J. Loze is master mechanic.

A $500,000 tannery to be equipped with the latest machinery will be erected at Milwaukee by the Fred Rueping Leather Company of Fond du Lac, Wis.

The United Engineering and Foundry Company, of Pittsburg, Pa., will build an addition to the erecting shop of the Lloyd-Booth Company at Youngstown, Ohio.

N. B. Hall & Sons, Decatur, Ala., are erecting a plant for the manufacture of slack barrel headings, which will be one of the largest of its kind in the south.

The Virginia Metal Culvert Company, Richmond, Va., incorporated to manufacture corrugated metal culverts, is erecting a plant. Address is 1703 East Cary street.

The Blount Plow Works Company has been incorporated at Evansville, Ind., to manufacture plows. H. H. Walter, E. Blount and William Davidson are directors.

The Fort William (Ont.) Car Company has been incorporated with a capital of $1,000,000 to build railroad cars. Frank Harold Lewis, Montreal, Que., is manager.

The Ocean Park Milling and Manufacturing Company, Venice, Cal., whose planing mill and manufacturing plant was recently destroyed by fire, is planning to rebuild.

The Logansport (Ind.) Radiator Company has been incorporated for the purpose of erecting a radiator factory. Capital $50,000. F. Digan and A. D. Benson are interested.

The Payne Lifting Jack Company, Belleville, Ill., has incorporated with $10,000 capital stock. A factory for the manufacture of jack screws on a large scale will be erected.

The Washington Steel and Bolt Company, Edmonds, Wash., is receiving bids on the steel plant it proposes to run in conjunction with the bolt works. A. G. Pike, general manager.

The Lake Shore & Michigan Southern Railway Company has purchased a site in Elkhart, Ind., to be used for a new locomotive shop. M. J. McCarthy, Elkhart, is master mechanic.

Contract has been let for the construction of a machine shop at San Bernardino, Cal., for the Atchison, Topeka & Santa Fe Railway Company which is to be twice the size of the present shop.

The Forrest City (Ark.) Box Company, recently incorporated, will erect a plant for the manufacture of box shooks. Building and machinery will cost $30,000. W. F. Perkins is engineer in charge.

The Thatcher A. Parker Company, Terre Haute, Ind., has been incorporated with $50,000 capital to establish and equip an iron factory. T. A. Parker, Warren Hussey and W. B. Hice, directors.

The Pittsburg (Pa.) Electro-Galvanizing Company has applied for charter. Capital, $15,000. The company will install equipment for electro-galvanizing pipe, bar, angles, etc. John A. Hanlon is president.

The Electrical Supply Company, of Valparaiso, Ind., has consolidated with the Trio Electrical Company, of Rock Island, Ill. A new plant will be erected at Rock Island, which will employ about 250 men.

The Maryland Elevator Safety Lock Company, Baltimore, Md., has been incorporated with $300,000 capital to manufacture elevator safety locks. Milton Dashiell, J. Taylor Albert, W. G. Menchine incorporators.

The C. G. Smith Company, Park building, Pittsburg, Penn., has purchased a site in North Rochester, and will erect a plant there for the manufacture of emery wheels, emery cloth, etc. About 200 men will be employed.

The machine shops of the Galveston, Houston & Henderson Railway Company, at Galveston, Texas, recently wrecked by a cyclone, will be reconstructed. The loss is said to be about $25,000, much of the machinery being totally ruined.

The repair shops of the Grand Trunk Railway Company at Stratford and Battle Creek, Mich., are being enlarged and reconstructed. A large sum of money will be expended by the company both for new buildings and modern machinery for these points.

Want Advertisements

Rate 25 cents a line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E.G.Smith Co., Columbia, Pa.

If you use small gears in large quantities, write Berry and Parker, Erie, Pa.

Working and patent drawings. G. M. Mayer, 1461 Monadnock Blk., Chicago.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machinery, jigs and fixtures designed, drawings from models or sketches. P. O. Box 1017, Lowville, N. Y.

Automatic machinery designed, ideas developed; work done by the hour. Box 739, AMERICAN MACHINIST.

Special machinery designed and built; duplicate parts, tools, jigs and dies. The Wade Machinery Co., 133 Oliver St., Boston.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Mechanics, write for our special offer of how to get a set of wrenches free. Bullard Automatic Wrench Co., Providence, R. I.

Designer of automatic and special machinery; mechanical drawings of any kind made. John G. Wittum, M. E., 93 Sherman Ave., Newark, N. J.

Lathe and machine work of every description, patterns, gear cutting, screw machine work, iron, brass and aluminum castings The Sipp Electric and Machine Co., Paterson, N. J.

Wanted—To correspond with individual or firm with a view to establishing agency for Electric Cranes in New York and Philadelphia territory. Box 730, AMER. MACHINIST.

For Minneapolis and St. Paul territory, manufacturer's agency for any meritorious article or machine, saleable to machine shop trade; we can sell it if it's "right." Roy Machinery Co., Minneapolis, Minn.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch pres and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, in the Hallenbeck building, 497-505 Pearl street, Borough of Manhattan, New York City, N. Y., on Tuesday, January 28, 1908, at 12 o'clock noon.
Dated, New York City, December 17th, 1907. Robert McKean, Secretary.

Machine work wanted; manufacturing company conveniently located in middle west with good shipping facilities, large new machine shop equipped with modern labor saving tools driven by individual variable speed motors, full complement traveling cranes, has surplus capacity, and would like an opportunity of figuring on machine work of any class from 16' diameter down; prepared to do machining alone or to furnish either steel or iron castings completely machined to gauge. Box 697, AMERICAN MACHINIST.

We want to purchase or handle the patents or designs for a line of machinists' tools or machine shop specialties; would prefer to take up some entirely new tools or a noticeably new design; we are willing to consider either the purchase of patent, manufacturing under royalty, or the introduction and selling of new tools, the manufacture of which is already started; we are located in New England and are experienced manufacturers and also salesmen of wide acquaintance and influence and wish to use this experience in bringing out a line of specialties Address with full particulars. Box 725, AM. MACH.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Mechanic; 27; 10 years' experience in first class tool and die making, 1 year in drawing room, spent 3 years in Europe; speaks Ger-

man and French; would make good traveling salesman or assistant foreman. Box 747, AMERICAN MACHINIST.

ILLINOIS

Assistant superintendent of a Connecticut factory wishes to locate in or near Chicago; three years in present position and five years previous experience in drafting room and machine shop; 32 years old; graduate of Yale; junior member A. S. M. E. Box 732, AMERICAN MACHINIST.

MASSACHUSETTS

All-around drop forging, die sinker, wishes to make a change; have had five years' experience. Write "J M. E.," 300 Main St., Easthampton, Mass.

NEW JERSEY

Situation wanted by technical graduate; 5 years' experience Box 733, AMER. MACH.

Mechanical draftsman, 35; can push work through office and shop. Box 746, AM. MACH.

A man of broad experience, thorough organizer and up to date producer; twenty years' manufacturing experience, twelve years as executive with one of the most progressive concerns; expert designer of large dies, of automatic and labor saving machinery; experienced superintendent of work requiring accuracy to be produced at low cost, practical, technical, resourceful, inventive; open for any responsible position. Box 740, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman wishes position. Address Box 744, AMERICAN MACHINIST.

Wanted—A position as chief engineer, mechanical and electrical; can furnish the best of references by inquiries. Box 183, AM. M.

Mechanical engineer; college graduate; one year shop, three years drafting experience, wants position. Box 743, AMER. MACHINIST.

Draftsman, graduated mechanical and electrical engineer, experienced; wishes position anywhere; small salary. Box 742, AM. M.

Mechanical draftsman; 6 years' experience on automatic machinery, pumping machinery, valves and automobiles, wants a position. Box 741, AMERICAN MACHINIST.

First-class tool designer; 30 years; college graduate; 10 years' practical and office experience; A-1 references; wants position. Box 745, AMERICAN MACHINIST.

Several years' experience in general drafting room work; best references furnished from previous employers; desires a reliable connection. Box 738, AMERICAN MACHINIST.

Mechanical draftsman and designer; college graduate with 5 years' practical experience on general engineering work and special machinery; wants position; A-1 references; salary $20 per week. Box 737, AMER. MACH.

Mechanical engineer, not a routine man, with 17 years' experience on light and heavy constructions, desires change; accustomed to heavy responsibilities, masses of detail; competent to direct technical, office and productive forces; fully posted on gas and oil engines and general industrial processes; possess numerous patents; am not particular about location. "Executive," AM. M.

OHIO

By a designing draftsman, several years' experience in automatic machinery, jigs, fixtures and tools; A-1 references. Box 728, AMERICAN MACHINIST.

Electrical engineer, designer, direct current motors and generators for all purposes; a practical mechanic, and familiar with every detail of manufacture; first-class references. Box 723, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

MASSACHUSETTS

Wanted—Cost estimator for electrical apparatus; must be able to figure from blueprints and specifications; must have thorough shop experience; only first-class man need apply; state age, name of last employer, qualifications, and salary expected. Box 735, AMERICAN MACHINIST.

Wanted—A thoroughly competent manager or foreman to take charge of the machine department of a manufacturing concern in southern Massachusetts; must be thoroughly familiar with modern methods and modern machine tools and must be a good executive prepared to undertake the management of 100 to 150 men engaged in the construction of small machines, the manufacture and repair of dies and general repair work. Box 736, AMERICAN MACHINIST.

NEW JERSEY

Draftsman on special machinery; must have shop and drawing room experience; man with executive experience preferred; state age, experience, also give references and salary. Box 731, AMERICAN MACHINIST.

NEW YORK

Wanted—An experienced draftsman of both mechanical and stuctural architectural drawing for a technical school; permanent position for first-class man. Apply by letter stating qualifications and experience in full. to Instruction Committee, P. O. Box 37, Station D, New York.

Machinist foreman; man under forty years old for small shop, capacity about thirty men, located in Greater New York, engaged on contract and experimental work; good equipment; steady position; good prospects for energetic, capable man; give age, outline of experience and education and salary required; correspondence confidential. Address A. D. & Co., Box 734, AMERICAN MACHINIST.

Superintendent with experience and good executive ability, capable of taking full charge of the manufacturing end of a modern plant employing 250 men in the manufacure of a line of fine machine tools; location a pleasant town of 10,000 inhabitants, moderate rents, etc.; this is a good opportunity for the right man; state age, experience and salary expected, with references. Address "Manufacturer," AMERICAN MACHINIST.

OHIO

Top notch foundry superintendent wanted at once for new machine-molding gray iron foundry; the various buildings and equipment just being completed; strictly up-to-date including continuous pouring; applicant must be temperate in habits, of good character, aggressive, and above all, a good executive; full knowledge of molding machines and best application of patterns thereto absolutely necessary; give full particulars, references, where employed at present, and state salary required; all communications treated confidentially; no cheap man need apply. Address The Cincinnati Milling Machine Co., Cincinnati, Ohio.

PENNSYLVANIA

Wanted—Machine shop foreman; one accustomed to steam engine work and general repairs; must be capable of handling 50 men and have usual qualifications. Box 729. AMERICAN MACHINIST.

Wanted—A first-class mechanic and die maker who wishes to get into business; I have a prosperous machine shop manufacturing business; foremanship position will be open. Benj. F. Bain, Pittsburg, Pa.

For Sale

For Sale—Foundry, wood and iron machine shop; all equipped. Box 74, Albion, N. Y.

For Sale—Back copies American Machinist, J. Beasley, Metropolitan Bldg., Orange, N. J.

For Sale—Two large Garvin hub machines for forming heavy work; will sell cheap. Schacht Mfg. Co., Cincinnati, O.

For Sale—Two pairs of Tabor steam engine indicators in good order, have been but little used. Address for full description and price. Box 727, AMERICAN MACHINIST.

For Sale—Ten volume library, covering completely the work of the engineer and machinist; good as new; cost $50; will sell for $15. Address "T. M. T.," Box 425, Chicago.

For Sale—Cyclopedia for modern shop practice, four volumes; bound in green morocco leather. Practically new; cost $18; will sell for $6. Address "L. N. O.," Box 425, Chicago, Ill.

For Sale—Some one with a line of light manufacture, can secure a fully equipped machine shop in modern brick building on side track in prosperous city by addressing Sauls Brothers, Columbus, Ga.

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Ingersoll-Rand Co., New York.

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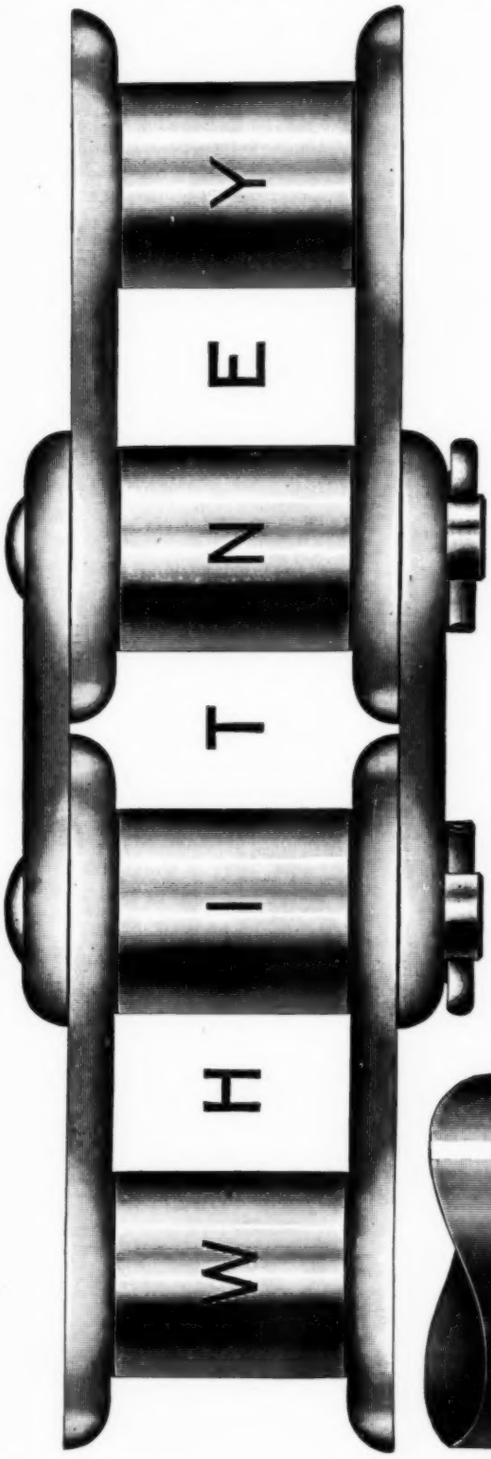
The Woodruff Patent System of Keying



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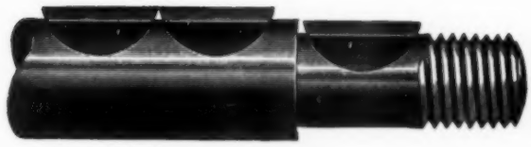

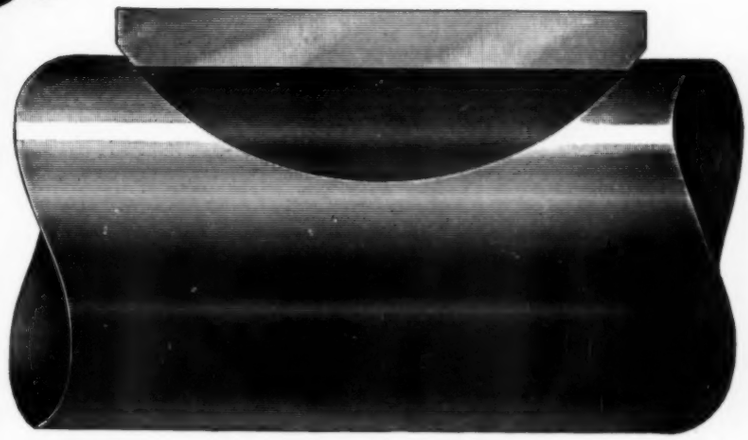

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Wiley & Russell Mfg. Co., Greenfield, Mass.

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National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening
Rogers & Hubbard Co., Middletown, Conn.

Books, Technical
American School of Correspondence, Chicago, Ill.
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Piers, Frank, Phila., Pa.
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Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Wilmington, Del.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, Ohio.
Manning, Maxwell & Moore, Inc., New York.
McCabe, J. J., New York.
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Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.

Boring and Turning Mills, Vertical—*Continued.*
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Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Manning, Maxwell & Moore, Inc., New York.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
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Armstrong Bros. Tool Co., Chicago, Ill.

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Cleveland Wire Spring Co., Cleveland, O.
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Industrial Oxygen Co., New York.
Reinforced Brazing & Machine Co., Pittsburg, Pa.

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Harrington, Son & Co., Edwin, Philadelphia, Pa.
Lapointe Mach. Tool Co., Hudson, Mass.

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National Machinery Co., Tiffin, O.
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Armstrong Bros. Tool Co., Chicago, Ill.
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Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

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Bilgram, Hugo, Phila., Pa.
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See Grinding Wheels.

Carborundum Paper and Cloth
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Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Carr & Co., Stuart R., Baltimore, Md.

Castings, Iron—*Continued.*
Cell Drier Machine Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Keystone Steel Casting Co., Chester, Pa.

Castings, Steel
Bethlehem Steel Co., So. Bethlehem, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cammel, Laird & Co., New York.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Keystone Steel Casting Co., Chester, Pa.
Krupp (Thos. Prosser & Son), New York.
Witteman & Co., A. P., Phila., Pa.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

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Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Manning, Maxwell & Moore, Inc., New York.
National Machine Co., The, Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

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Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Cullman Wheel Co., Chicago, Ill.
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Link-Belt Co., Philadelphia, Pa.
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Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

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Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Manning, Maxwell & Moore, Inc., New York.
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Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

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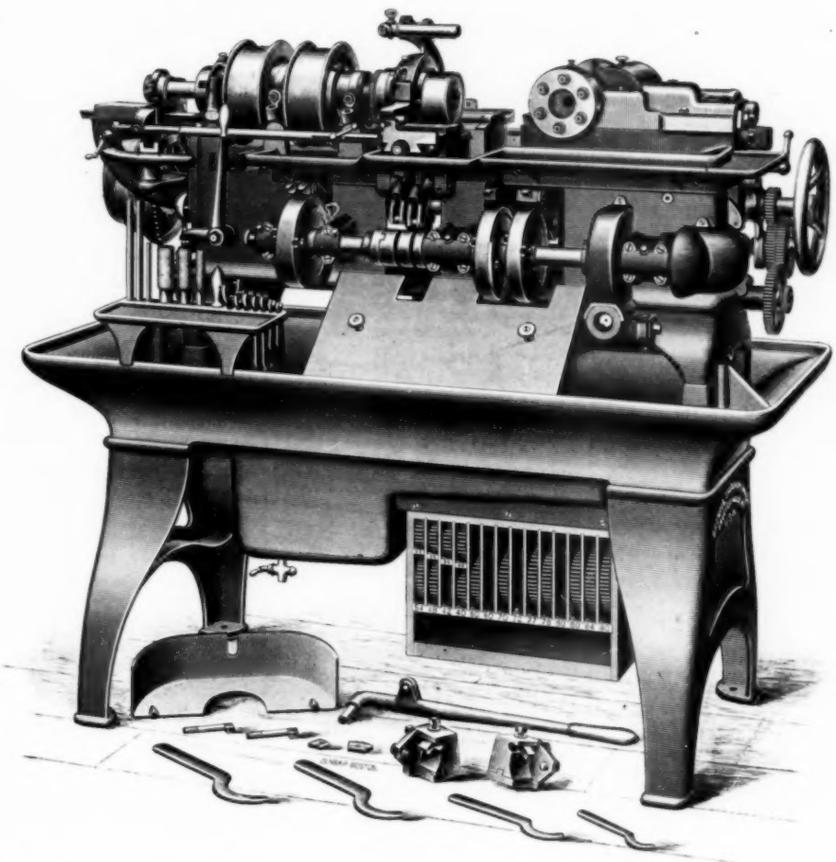
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Brown & Sharpe Mfg. Co.

Providence, R. I., U. S. A.

B. & S. Automatic Screw Machines



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With B. & S. Automatic Screw Machines

you combine rapidity and accuracy and, therefore, reproduce parts economically.

No. 2 Automatic Screw Machine

(SHOWN IN CUT)

Capacity:

Hole through largest feeding finger 7-8". Turns any length, 2½".
Change gears provide for making from 20 to 600 pieces per hour.

Write for a circular descriptive of this machine.

Chucks, Lathe

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Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

Niles-Bement-Pond Co., New York.
Reed Co., Francis, Worcester, Mass.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split

Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.

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Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
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Tudor Mfg. Co., Taunton, Mass.
Williams & Co., J. H., Brooklyn, N. Y.

Clutches, Friction

Caldwell, Son & Co., H. W., Chicago, Ill.
Cowanesque Valley Iron Wks., Cowanesque, Pa.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Clutches, Magnetic

Electric Controller & Supply Co., Cleveland, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Coils

Standard Welding Co., Cleveland, Ohio.

Collets and Attachments, Spring

Adjustable Collet Co., Cleveland, Ohio.

Compound, Core

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Cambridge, Mass.
Bury Compressor Co., Erie, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.
Curtis & Co. Mfg.. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Sampson & Co., Geo. H., Boston, Mass.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Blaisdell Machinery Co., Bradford, Pa.

Conduit, Interior

Sprague Electric Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Bethlehem Steel Co., So. Bethlehem, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Cambridge, Mass.
Cell Drier Machine Co., Taunton, Mass.
Ingle Machine Co., Rochester, N. Y.
Manville Bros. Co., Waterbury, Conn.
Merritt, Jos., Hartford, Conn.
Turner Mach. Co., Danbury, Ct.

Controllers and Starters, Electric Motor

Case Mfg. Co., Columbus, O.
Crocker - Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, O.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic

Link-Belt Co., Philadelphia, Pa.

Coping Machines

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Corundum

See Grinding Wheels.

Cotters

Adjustable Collet Co., Cleveland, Ohio.
Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Machinery

Veeder Mfg. Co., Hartford, Conn.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y
Builders Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Manning, Maxwell & Moore, Inc., New York.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Evans Friction Cone Co., Newton Centre, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Ingersoll-Rand Co., New York.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.

Couplings, Shaft—*Continued.*

Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., New York.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.

Cranes

Box & Co., Alfred, Phila., Pa.
Brown Hoisting Mach. Co., Cleveland, O.
Byram & Co., Inc., Detroit, Mich.
Case Mfg. Co., Columbus, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Manning, Maxwell & Moore, Inc., New York.
Maris Bros., Philadelphia, Pa.
Moore Co., Franklin, Winsted, Ct.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crane Pullers

Walker, N. U., Boston, Mass.

Crank Pin Turning Machines

Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Bethlehem Steel Co., So. Bethlehem, Pa.
Krupp (Thos. Prosser & Son), New York.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry

Byram & Co., Inc., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil

Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Elliott Chemical Works, Newton, Mass.
Lunkenheimer Co., Cincinnati, O.
Winkley Co., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Pratt & Whitney Co., Hartford, Conn.

Cutters, Milling—*Continued.*

Rogers Works, Jno. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines

Armstrong Bros. Tool Co., Chicago, Ill.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Hill, Clarke & Co., Inc., Boston, Mass.
Huribut-Rogers Mach. Co., South Sudbury, Mass.
Manning, Maxwell & Moore, Inc., New York.
Newton Mach. Tool Wks., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Schmitz, August, Dusseldorf, Germany.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.

Cutting-off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, O.

Diamond Tools

American Emery Wheel Co., Providence, R. I.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Globe Machine & Stamping Co., Cleveland, O.
Manville Bros. Co., Waterbury, Conn.
Risdon Tool Works, Waterbury, Conn.
Swaine Mfg. Co., Fred J., St. Louis, Mo.
Toledo Machine & Tool Co., Toledo, O.

Dies, Sub-Press

Risdon Tool Works, Waterbury, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Errington, F. A., New York.
Foote-Burt Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

Dowel Pins

Winkley Co., Hartford, Conn.

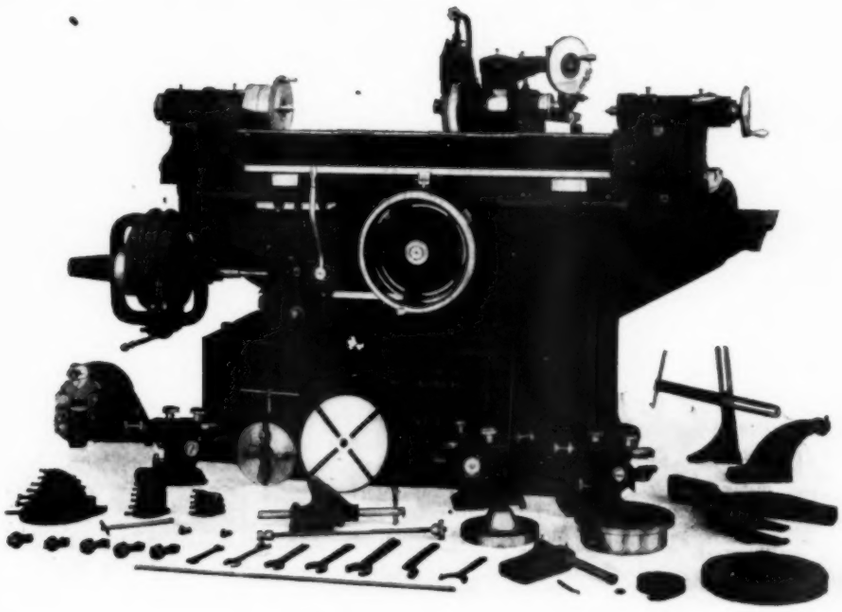
Drawing Boards and Tables

Alteneder & Son, Theo., Philadelphia, Pa.
Artisans Guild, Benton Harbor, Mich.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.
Mittineague Paper Co., Mittineague, Mass.

Drawing Materials

Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.

A UNIVERSAL PROPOSITION



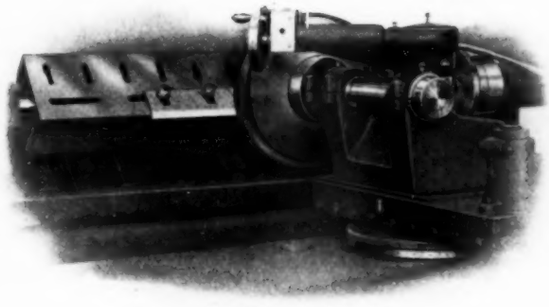
12" x 42"

Our No. 3 Universal shown in accompanying cut is an excellent one for general use.

If your shop requires a machine adapted for tool room and manufacturing purposes combined, we would recommend this one, however, we have all kinds to select from.

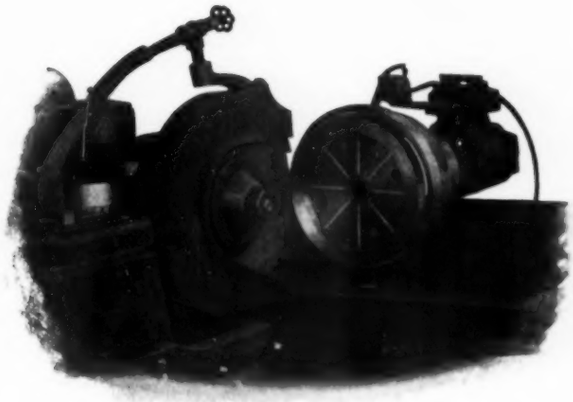
Our 1908 catalogue is ready for delivery.

Two Of The Attachments For LANDIS UNIVERSAL GRINDING MACHINES



PLAIN SURFACE AND KNIFE GRINDING ATTACHMENT

A device for converting a cylindrical grinding machine into a surface grinding machine. It consists of a tilting table which is held on the bed between the centers by a support or bracket for securing same in all positions, from 90 degrees to zero, the circular flange by which it is clamped being graduated. A special grinding wheel head is used in place of the regular wheel head. The grinding is done with the side of a cylindrical wheel which produces a straight surface. This attachment is adapted for handling a great variety of work such as shear blades, planer and paper knives, square bars, etc. Provision is made for the free use of water, which is essential in all operations of grinding.



MAGNETIC CHUCK

This is attached to the Universal Machine by screwing on the headstock spindle, taking the place of the regular work-driving pulley. It is driven by a fixed pulley on the spindle which is located back of chuck next to bearing in headstock. This chuck is suitable for handling such work as grinding the sides of plates, saws, milling cutters, washers, etc. One of its applications is here illustrated.

We are grinding specialists and manufacture a full line of grinding machines, including Universal, Plain, Internal, Ball Race and Crank Grinding Machines.

LANDIS TOOL CO., Waynesboro, Pa., U. S. A.

AGENTS—Modern Machinery and Engineering Co., 309 Schofield Bldg., Cleveland, Ohio. Marshall & Huschart Machinery Co., 64 So. Canal St., Chicago, Ill. Walter H. Foster Co., 114 Liberty St., New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte Berlin, Vienna Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Drawing Materials—*Cont.*

Mittineague Paper Co., Mittineague, Mass.
Technical Supply Co., Scranton, Pa.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Manning, Maxwell & Moore, Inc., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O

Drilling Machines, Boiler

American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

Drilling Machines, Electric

Chicago Pneumatic Tool Co., Chicago, Ill.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Independent Pneumatic Tool Co., Chicago, Ill.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
National Machine Co., The, Hartford, Conn.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., Francis, Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Ct.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, Ohio.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Drilling Machines, Turret

Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co. Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Kern Machine Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Machine Co., The, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., Francis, Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Drills, Center

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic

Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.

Drills, Rail

Foote-Burt Co., Cleveland, O.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Cleveland Twist Drill Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cin., O.
Manning, Maxwell & Moore, Inc., New York.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock

Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder

Graham Mfg. Co., Providence, R. I.

Drying Apparatus

Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker - Wheeler Co., Ampere, N. J.
Eck Dynamo and Motor Co., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies

Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Crocker - Wheeler Co., Ampere, N. J.
Electric Controller & Supply Co., Cleveland, Ohio.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Triumph Electric Co., Cincin., O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., Chicago, Ill.
Weston Elec. Instrument Co., Newark, N. J.
Westinghouse Elec. & Mfg. Co. Pittsburg, Pa.

Electrically Driven Tools and Machinery

American Tool Wks. Co., Cin., O.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.

Electrically Driven Tools and Machinery—*Continued.*

Crescent Forgings Co., Oakmont, Pa.
Electric Controller & Supply Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cincin., O.
Manning, Maxwell & Moore, Inc., New York.
Roth Bros. & Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.
Western Electric Co., Chicago, Ill.

Elevators

Albro-Clem Elevator Co., Philadelphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

American Emery Wheel Co., Providence, R. I.
Bay State Stamping Co., Worcester, Mass.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-Room

Hart & Cooley Co., New Britain, Conn.
Merritt & Co., Philadelphia, Pa.

Engineering Appliances

Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Engineers, Mechanical and Electrical

Crocker - Wheeler Co., Ampere, N. J.
Jackson, Henry Docker, Boston, Mass.
Merritt, Jos., Hartford, Conn.
Seaver, John W., Cleveland, O.

Engines, Gas and Gasolene

Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Olds Gas Power Co., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Motor

Franklin Mfg. Co., H. H., Syracuse, N. Y.
Olds Gas Power Co., Lansing, Mich.
Ridgway Dynamo & Engine Co., Ridgway, Pa.

Engines, Steam

Garden City Fan Co., Chicago, Ill.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery

Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads

Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition Machinery

Philadelphia Bourse, Phila., Pa.

Expanders, Tube

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Factory Equipment

Lyon Metallic Mfg. Co., Aurora, Ill.
Mfg. Equipment & Eng. Co., Boston, Mass.

Fans, Electric

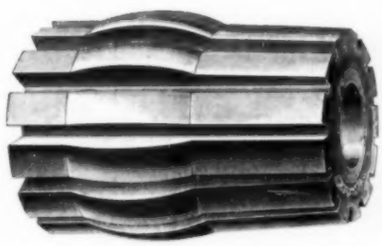
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

"MORSE"

A shop equipped with tools made by the "Morse" Company is always ready for emergencies.

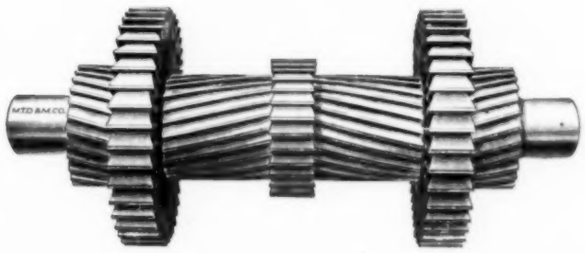
DRILLS, REAMERS, CUTTERS, CHUCKS, TAPS, DIES, ARBORS, COUNTERBORES, COUNTERSINKS, GAUGES, MACHINES, MANDRELS, MILLS, SCREW PLATES, SLEEVES, SOCKETS, TAPER PINS & WRENCHES.

All of our tools are made of the best materials by the best workmen, therefore they are accurate and reliable.



Morse Twist Drill & Machine Co.

New Bedford, Mass., U. S. A.



Fans, Electric—*Continued.*
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Crocker - Wheeler Co., Ampere, N. J.
Garden City Fan Co., Chicago, Ill.
General Electric Co., Phila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps
American Swiss File & Tool Co., New York.
Barnett Co., G. & H., Phila., Pa.
Carver File Co., Philadelphia, Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Phila., Pa.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Henry & Wright Mfg. Co., Hartford, Conn.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Manning, Maxwell & Moore, Inc., New York.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Burke Machy. Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Miner & Peck Mfg. Co., New Haven, Conn.
National Machinery Co., Tiffin, O.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Bethlehem Steel Co., So. Bethlehem, Pa.
Billings & Spencer Co., Hartford, Conn.
Brown & Co., R. H., New Haven, Conn.
Crescent Forgings Co., Oakmont, Pa.
Krupp (Thos. Prosser & Son), New York.
O. K. Tool Holder Co., Shelton, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Forgings, Hydraulic
Bethlehem Steel Co., So. Bethlehem, Pa.

Forgings, Machine
Dyson & Sons, Jos., Cleveland, O.

Forgings, Steel
Bethlehem Steel Co., So. Bethlehem, Pa.
Cammel, Laird & Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Krupp (Thos. Prosser & Son), New York.
Tindel-Morris Co., Eddystone, Pa.
Witteman & Co., A. P., Phila., Pa.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Byram & Co., Inc., Detroit, Mich.
Goldschmidt Thermit Co., New York.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Annealing and Tempering—*Continued.*
Westmacott Gas Furnace Co., Providence, R. I.
Witteman & Co., A. P., Phila., Pa

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Nash Company, Geo., New York.
Obermayer Co., S., Cincinnati, O.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.
Nash Company, Geo., New York.
Westmacott Gas Furnace Co., Providence, R. I.

Furnaces, Oil
Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop
Hart & Cooley Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Manufacturing Equip. & Engineering Co., Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Ames & Co., B. C., Waltham, Mass.
Athol Machine Co., Athol, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Wks., Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

Gages, Steam
Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Flather Mfg. Co., E. J., Nashua, N. H.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., New York.
Morse, Williams & Co., Phila., Pa.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Flather Mfg. Co., E. J., Nashua, N. H.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Wks., Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
Lea Equipment Co., New York.
Morse, Williams & Co., Phila., Pa.
Mutual Machine Co., Hartford, Conn.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waterbury Gear Co., Waterbury, Conn.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Horsburgh & Scott Co., Cleveland, Ohio.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.

Gears, Rawhide
Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Horsburgh & Scott Co., Cleveland, O.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton, Cleveland, O.

Generating Sets
Burke Electric Co., Erie, Pa.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York
Northern Electric Mfg. Co., Madison, Wis.

Generating Sets—*Continued.*
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Knife
American Wood Working Mchy. Co., Rochester, N. Y.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Gem Mfg. Co., Pittsburg, Pa.
Heald Mach Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cin., O.
Manning, Maxwell & Moore, Inc., New York.
Mueller Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cutter
Bath Grinder Co., Inc., Fitchburg, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Crocker - Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Manning, Maxwell & Moore, Inc., New York.
National Machine Co., The, Hartford, Conn.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical
Bath Grinder Co., Inc., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Bath Grinder Co., Inc., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Machine Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Manning, Maxwell & Moore, Inc., New York.
Safety Emery Wheel Co., Springfield, O.
Taylor & Fenn Co., Hartford, Ct.

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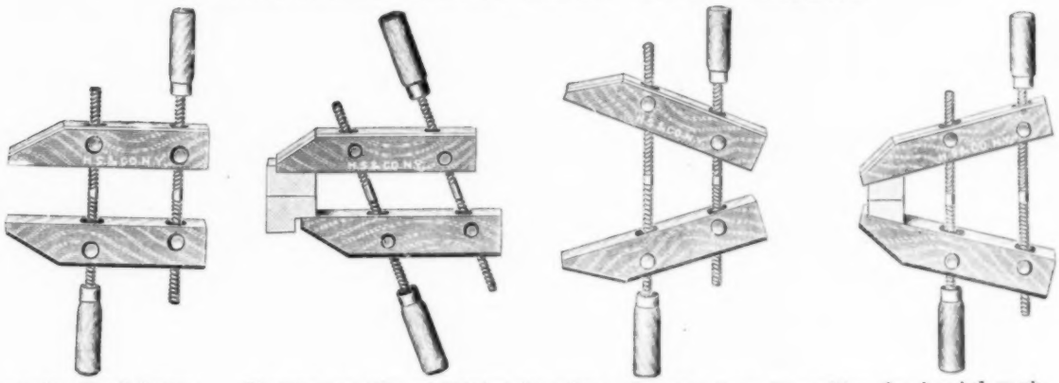
JORGENSEN ADJUSTABLE HAND SCREWS



As a regular Hand Screw — Showing one jaw overlapping the other — Showing jaws in position for beveled work.

A single clamp will adjust to any one of the positions shown or any modification of them.

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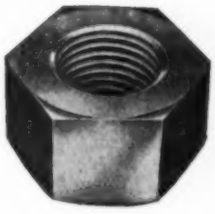

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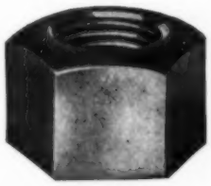


Finished.

Grinders, Drill

Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Manning, Maxwell & Moore, Inc., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Bath Grinder Co., Inc., Fitchburg, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Manning, Maxwell & Moore, Inc., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.

Grinders, Portable

Cincinnati Eletcrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
U. S. Electrical Tool Co., Cin., O.

Grinders, Saw

Tindel-Morris Co., Eddystone, Pa.

Grinders, Surface

National Machine Co., Hartford, Conn.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Inc., Fitchburg, Mass.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Diamond Machine Co., Providence, R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Manning, Maxwell & Moore, Inc., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Mummert, Wolf & Dixon Co., Hanover, Pa.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cin., O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding or Polishing Machinery

Abrasive Material Co., Philadelphia, Pa.
American Emery Wheel Co., Providence, R. I.
Barnes Co., W. F. & John, Rockford, Ill.
Bath Grinder Co., Inc., Fitchburg, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.

Grinding or Polishing Machinery—*Continued.*

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Burke Machry Co., Cleveland, O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker - Wheeler Co., Ampere, N. J.
Diamond Machine Co., Providence, R. I.
Gardner Mach. Co., Beloit, Mich.
Graham Mfg. Co., Providence, R. I.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
Monarch Emery & Cor. Wheel Co., Camden, N. J.
National Machine Co., The, Hartford, Conn.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Safety Emery Wheel Co., Springfield, O.
Stow Mfg. Co., Binghamton, N. Y.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.

Grinding Wheels

Adams Co., Dubuque, Iowa.
American Emery Wheel Co., Providence, R. I.
Best & Co., L., New York.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Carborundum Co., Niagara Falls, N. Y.
Diamond Machine Co., Providence, R. I.
Monarch Emery & Cor. Wheel Co., Camden, N. J.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames

Athol Machine Co., Athol, Mass.
Cleveland Stone Co., The, Cleveland, O.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.

Gun Barrel Machinery

Diamond Machine Co., Povidence, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Hammers, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toledo Machine and Tool Co., Toledo, Ohio.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic

Chicago Pneumatic Tool Co., Chicago, Ill.
Clayton Air Compressor Works, New York.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sampson & Co., Geo. H., Boston, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Hammers, Power

Beaudry & Co., Inc., Boston, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Hammers, Steam

Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Handles, Machine Tool

Whitman & Barnes Mfg. Co., Chicago, Ill.

Hangers, Shafting

Link-Belt Co., Philadelphia, Pa.

Heaters, Feed Water

Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus

Garden City Fan Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Hobbing Machines, Worm

Gould & Eberhardt, Newark, N. J.
Pratt & Whitney Co., Hartford, Conn.

Hoisting and Conveying Machinery

Box & Co., Alfred, Phila., Pa.
Brown Hoisting Machinery Co., Cleveland, O.
Case Mfg. Co., Columbus, O.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Link-Belt Co., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., New York.
Moore Co., Franklin, Winsted, Ct.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Yale & Towne Mfg. Co., New York.

Hoists, Electric

C & C Electric Co., New York.
Case Mfg. Co., Columbus, O.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker - Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
General Pneumatic Tool Co., Montour Falls, N. Y.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Case Mfg. Co., Columbus, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Moore Co., Franklin, Winsted, Ct.
Nicholls, Wm. S., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Chicago Flexible Shaft Co., Chicago, Ill.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.

Hones

Carborundum Co., Niagara Falls, N. Y.
Chicago Pneumatic Tool Co., Chicago, Ill.

Hose

Chicago Pneumatic Tool Co., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Rhoads & Son, J. E., Phila., Pa.
Sprague Electric Co., New York.

Igniters, Gas Engine

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Indicators, Speed

Warner Instrument Co., Beloit, Wis.

Indicators, Steam Engine

Crosby Steam Gage & Valve Co., Boston, Mass.

Indicators, Test

Grant Mfg. & Mach. Co., Bridgeport, Conn.
Norton Grinding Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Injectors

Desmond-Stephan Mfg. Co., Urbana, O.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Inspection and Tests

Hunt Co., Robert W., Chicago, Ill.

Instruments, Electric

General Electric Co., New York.
Weston Elec. Instrument Co., Newark, N. J.

Iron Bar

Milton Mfg. Co., Milton, Pa.

Jacks, Hydraulic

Burroughs Co., Chas., Newark, N. J.
Watson-Stillman Co., New York.

Jacks, Planer

Armstrong Bros. Tool Co., Chicago, Ill.

Jacks, Lever and Screw

Watson-Stillman Co., New York.

Kettles, Soda

Brown & Sharpe Mfg. Co., Providence, R. I.
Gray & Prior Mach. Co., Hartford, Conn.
Mfg. Equip. & Engineering Co., E. Boston, Mass.

Key Seaters

Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Burr & Sons, John T., Brooklyn, N. Y.
Davis Machine Co., W. P., Rochester, N. Y.
Lapointe Mach. Tool Co., Hudson, Mass.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
Morton Manufacturing Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Machine

Coes Wrench Co., Worcester, Mass.

Knurls

Hammacher, Schlemmer & Co., New York.

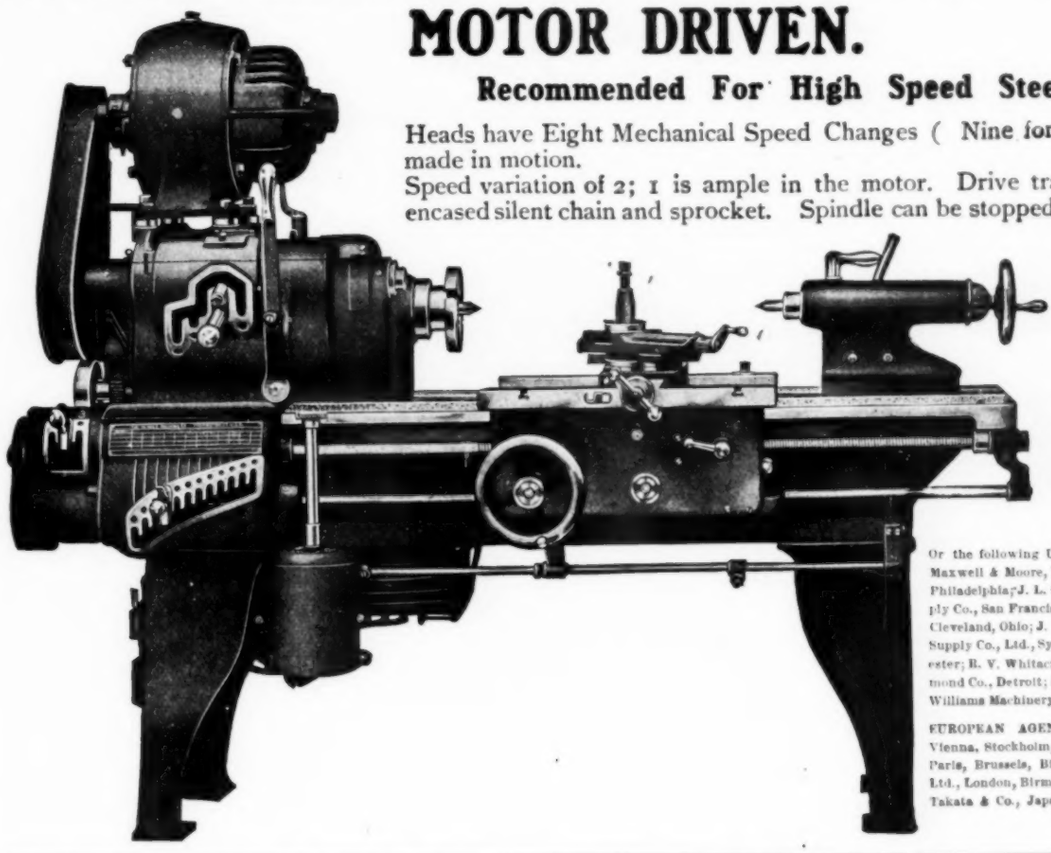
Lamps, Arc

General Electric Co., New York.
Turner Brass Works, Sycamore, Ill.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments

American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.

ENGINE LATHES WITH ALL-GEARED HEADS MOTOR DRIVEN.



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Heads have Eight Mechanical Speed Changes (Nine for 20") which can be made in motion.

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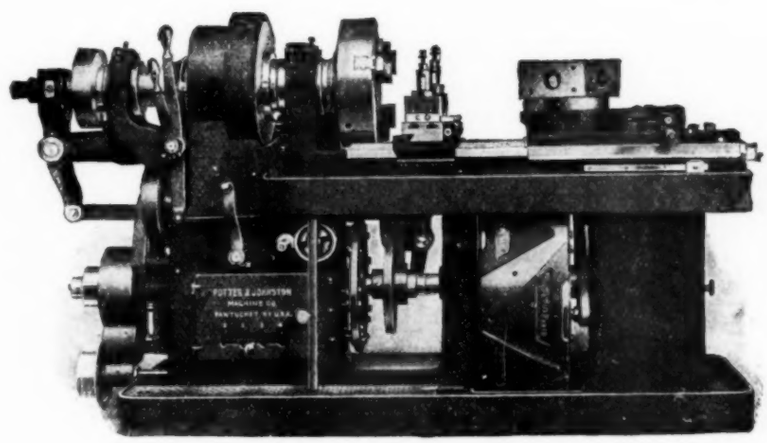

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Saunders Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

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Cincinnati Planer Co., Cincin., O.
Gray Co., G. A., Cincinnati, O.
Reed Co., F. E., Worcester, Mass.

Planer Tools
Armstrong Bros. Tool Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.

Planers
American Tool Wks. Co., Cin., O.
Betts Mach. Co., Wilmington, Del.
Cincinnati Planer Co., Cincin., O.
Cleveland Planer Works, Cleveland, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Machine Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Conn.
Manning, Maxwell & Moore, Inc., New York.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm, Philadelphia, Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Planers, Gear
Gleason Works, Rochester, N. Y.

Planers, Portable
Manning, Maxwell & Moore, Inc., New York.
Morton Manufacturing Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., New York.

Planers, Rotary
Newton Machine Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Tindel-Morris Co., Eddystone, Pa.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Wood
American Wood Working Mchy. Co., Rochester, N. Y.

Plates, Welding
Phillips-Laffitte Co., Philadelphia, Pa.

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American Watch Tool Co., Waltham, Mass.
Manning, Maxwell & Moore, Inc., New York.
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Rivett Lathe Mfg. Co., Boston, Mass.
Sloan & Chace Mfg. Co., Newark, N. J.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

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Consolidated Press & Tool Co., Hastings, Mich.
Prentiss Tool & Supply Co., New York.
Watson-Stillman Co., New York.

Presses, Drop
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Bliss Co., E. W., Brooklyn, N. Y
Consolidated Press and Tool Co., Hastings, Mich.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Swaine Mfg. Co., Fred J., St. Louis, Mo.

Presses, Foot and Hand
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press & Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Leonard Mfg. Co., Providence, R. I.
Manville Bros. Co., Waterbury, Conn.
Swaine Mfg. Co., Fred J., St. Louis, Mo.
Taylor & Fenn Co., Hartford, Ct.

Presses, Forging
Consolidated Press & Tool Co., Hastings, Mich.
Niles Bement-Pond Co., New York.

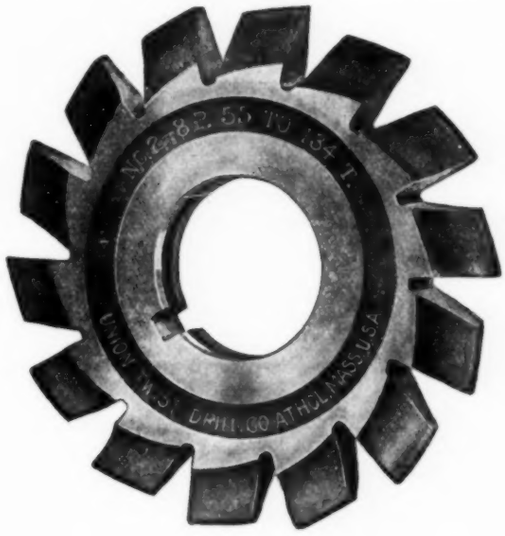
Presses, Hydraulic
Burroughs Co., Charles, Newark, N. J.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Watson-Stillman Co., New York.

Presses, Power
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Foundry & Mach. Co., South Bethlehem, Pa.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press & Tool Co., Hastings, Mich.
Dill Slotter People, Philadelphia, Pa.
Ferracute Machine Co., Bridgeton ,N. J.
Lucas Mach. Tool Co., Cleve., O.
Manning, Maxwell & Moore, Inc., New York.
Manville Bros. Co., Waterbury, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

STANDARDS.

A knowledge of the practical use of cutters, as well as the details of their manufacture, led us to realize the value of the establishment of a NEW STANDARD.

An extensive experience made it possible to make such improvements and changes as to originate such a standard, and our cutters are now universally recognized and considered by discriminating buyers as THE STANDARD.



The advancement made in machine tools and the greater accuracy demanded should cause every user of cutters to seriously consider the necessity of obtaining a *superior* grade, and our line has been developed with the idea of meeting this demand.

We would appreciate the privilege of offering our advice and submitting sketches showing arrangement of cutters we would recommend for any special work.

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Presses, Power—*Continued.*

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Swaine Mfg. Co., Fred J., St. Louis, Mo.
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Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Presses, Screw

Barnes Co., W. F. & John, Rockford, Ill.
Consolidated Press & Tool Co., Hastings, Mich.

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Backus Water Motor Co., Newark, N. J.

Profilers

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Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Garvin Machine Co., New York.
Pratt & Whitney Co., Hartford, Conn.

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Henley Pub. Co., N. W., New York.
Hill Publishing Co., New York.

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American Tool & Machine Co., Boston, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
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Eastern Machinery Co., New Haven, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Niles Bement Pond Co., New York.
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Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

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Ingersoll-Rand Co., New York.

Pumps, Electric

General Electric Co., New York.

Pumps, Hydraulic

Burroughs Co., Charles, Newark, N. J.
Elmes Engineering Wks., Chas. F., Chicago, Ill.
General Electric Co., New York.
Watson-Stillman Co., New York.

Pumps, Steam

Clayton Air Compressor Works, New York.
Ingersoll-Rand Co., New York.

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Hammacher, Schlemmer & Co., New York.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Starrett Co., L. S., Athol, Mass.

Punches, Hand

Armstrong-Blum Mfg. Co., Chicago, Ill.
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Sellers & Co., Inc., Wm., Philadelphia, Pa.

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Burroughs Co., Chas., Newark, N. J.
Elmes Engineering Wks., Chas. F., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Watson-Stillman Co., New York.

Punches, Power

Bertsch & Co., Cambridge City, Ind.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.

Punches, Power

Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Long & Allstatter Co., Hamilton, Ohio.
Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.
Royersford Foundry & Mach. Co., Royersford, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Pyrometers, Electric

Bristol Co., Waterbury, Conn.
Bristol, Wm. H., New York.

Racks, Cut

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Cleveland Wire Spring Co., Cleveland, O.
Fellows Gear Shaper Co., Springfield, Vt.
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Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Walcott & Wood Mach. Tool Co., Jackson, Mich.

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Adams Co., Dubuque, Iowa.
Fellows Gear Shaper Co., Springfield, Vt.
Flather Mfg. Co., E. J., Nashua, N. H.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Manning, Maxwell & Moore, Inc., New York.
Reed Co., F. E., Worcester, Mass.
Sloan & Chace Mfg. Co., Newark, N. J.
Walcott & Wood Mach. Tool Co., Jackson, Mich.

Racks, Tool

Lyon Metallic Mfg. Co., Aurora, Ill.
Mfg. Equipment & Engineering Co., East Boston, Mass.
New Britain Mach. Co., New Britain, Conn.
Western Tool & Mfg. Co., Springfield, O.

Radiators, Japanning Oven

American Gas Furnace Co., New York.

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Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Chadwick & Trefethen, Portsmouth, N. H.
Cleveland Twist Drill Co., Cleveland, O.
Clough, R. M., Tolland, Conn.
Gisholt Mach. Co., Madison, Wis.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., The, Cleveland, O.
Latrobe Mach. Tool Co., Hudson, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Nash Company, Geo., New York.
Patterson, Gottfried & Hunter Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Smith & Co., Wm. J., New Haven, Conn.
Standard Tool Co., Cleveland, O.
Ward & Son, Edgar T., Boston, Mass.
Western Tool & Mfg. Co., Springfield, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Reamer Stands

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Skinner Chuck Co., New Britain, Conn.

Recorders, Speed

Warner Instrument Co., Beloit, Wis.

Rehenters, Steam

Ingersoll-Rand Co., New York.

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Electric Controller and Supply Co., Cleveland, Ohio.
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Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Standard Welding Co., Cleve., O.

Riveters, Hydraulic

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Hanna Engineering Works, Chicago, Ill.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Watson-Stillman Co., New York.

Riveters, Pneumatic

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General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Riveters, Steam

Chambersburg Engineering Co., Chambersburg, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Riveting Machines

Bethlehem Foundry and Machine Co., South Bethlehem, Pa.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Long & Allstatter Co., Hamilton, Ohio.
Manning, Maxwell & Moore, Inc., New York.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Rolling Mill Machinery

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bill Shotter People, Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Schmitz, August, Dusseldorf Germany.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Rules, Steel

Athol Machine Co., Athol, Mass.
Billings & Spencer Co., Hartford, Conn.
Hammacher, Schlemmer & Co., New York.
Keuffel & Esser Co., New York.
Lufkin Rule Co., Saginaw, Mich.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Sand Blast Apparatus

Drucklieb, C., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.

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Athol Machine Co., Athol, Mass.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Hammacher, Schlemmer & Co., New York.
Massachusetts Saw Works, Chicopee, Mass.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Saw Frames and Blades, Hack—*Continued.*

Starrett Co., L. S., Athol, Mass.
Tindel-Morris Co., Eddystone, Pa.
West Haven Mfg. Co., New Haven, Conn.

Saw Sharpening Machines

Cochrane-Bly Co., Rochester, N. Y.

Sawing Machines, Metal

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Burr & Son, John T., Brooklyn, N. Y.
Cochrane-Bly Co., Rochester, N. Y.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Lea Equipment Co., New York.
Manning, Maxwell & Moore, Inc., New York.
Newton Machine Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Smith & Post Co., Milwaukee, Wis.
Tabor Mfg. Co., Philadelphia, Pa.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood

American Wood Working Mchry. Co., Rochester, N. Y.
Colburn Mach. Tool Co., Franklin, Pa.
Greaves, Klusman & Co., Cin., O.
Marston & Co., J. M., Boston Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Saws, Metal Band

Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Saws, Power Hack

Diamond Saw & Stamping Works, Buffalo, N. Y.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Schools, Correspondence

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International Correspond. Schools, Scranton, Pa.

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Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machinery Co., Chicago, Ill.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Universal Machine Screw Co., Hartford, Conn.

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Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Garvin Machine Co., New York.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Jones & Lamson Mach. Co., Springfield, Vt.
Manning, Maxwell & Moore, Inc., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe Mfg. Co., Boston, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

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Cook Co., Asa S., Hartford, Conn.
Hammacher, Schlemmer & Co., New York.

Screw Plates

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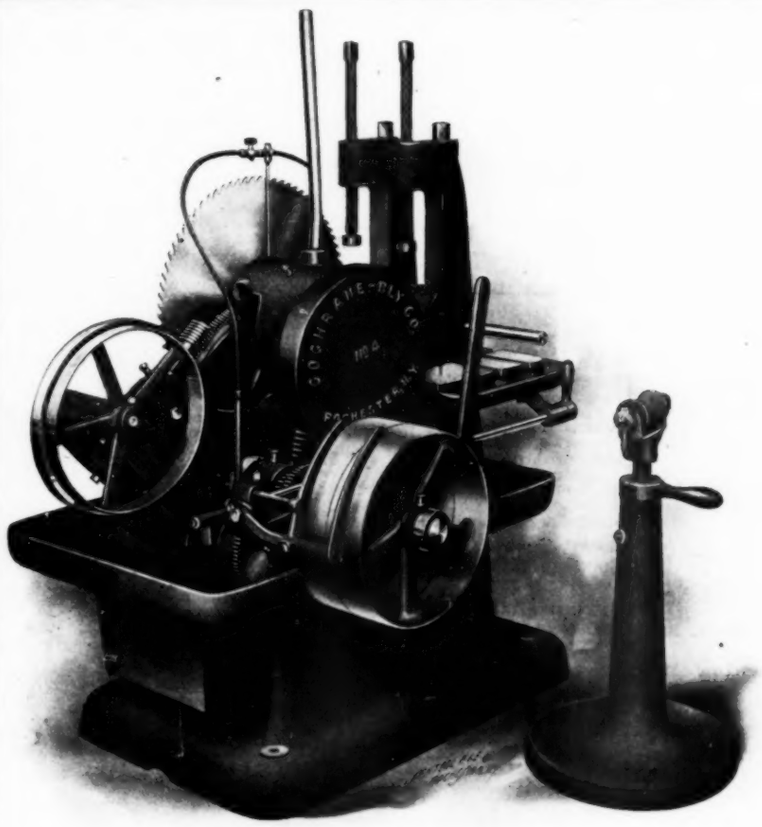
Billings & Spencer Co., Hartford, Conn.



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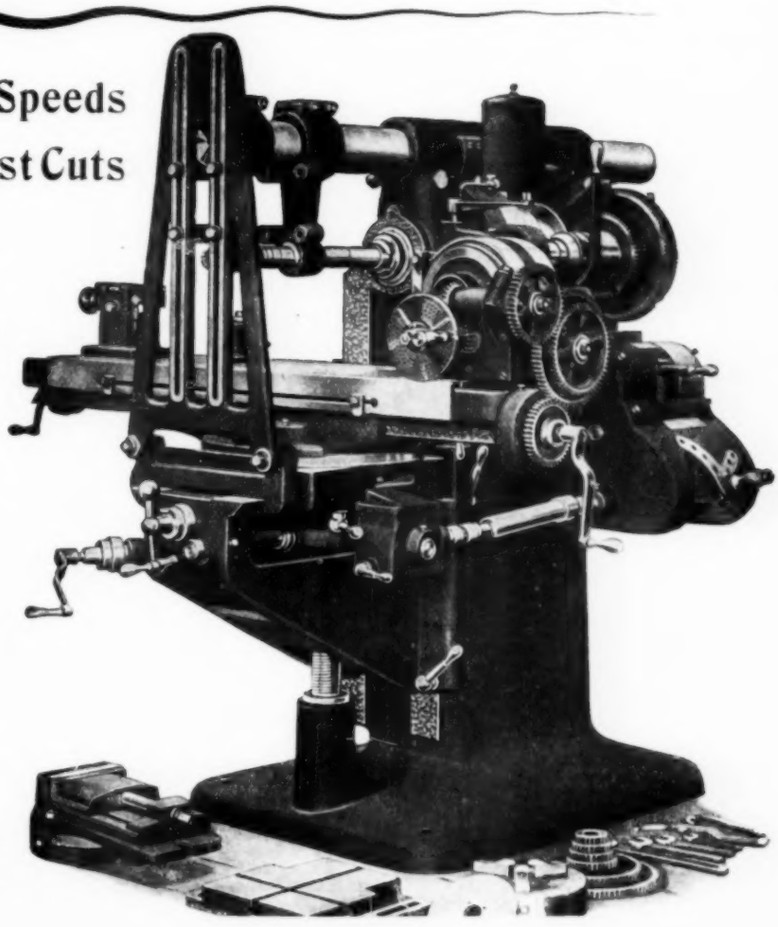

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Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Screws, Cap and Set
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.
Worcester Machine Screw Co., Worcester, Mass.

Screws, Machine
Cleveland Cap Screw Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Machine Screw Products Co., Providence, R. I.
National-Acme Mfg. Co., Cleveland, O.
Standard Gauge Steel Co., Beaver Falls, Pa.
Universgal Machine Screw Co., Hartford, Conn.
Worcester Machine Screw Co., Worcester, Mass.

Second Hand Machinery
American Tool Wks. Co., Cin., O.
Davis Machine Co., W. P., Rochester, N. Y.
Garvin Machine Co., New York.
Hill, Clarke & Co., Inc., Boston, Mass.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machinery Co., Cleveland, O.
McCabe. J. J., New York.
McLauthlin & Co., Geo., Boston, Mass.
Motch & Merryweather Machry. Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
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Wormer Machry. Co., C. C., Detroit, Mich.

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General Electric Co., New York.

Separators, Oil and Steam
American Tool & Machine Co., Boston, Mass.
Nicholson & Co., W. H., Wilkesbarre, Pa.

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Nash Company, Geo., New York.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

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Boynton & Plummer, Worcester, Mass.
Cincinnati Shaper Co., Cincin., O.
Cochrane-Bly Co., Rochester, N. Y.
Davis Machine Co., W. P., Rochester, N. Y.
Fitchburg Machine Works, Fitchburg, Mass.
Flather Planer Co., Mark, Nashua, N. H.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Mach. Co., Torrington, Conn.
Juengst & Sons, Geo., Croton Falls, N. Y.
Kelly Mach. Co., R. A., Xenia, O.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machinery Co., Chicago, Ill.
Morton Manufacturing Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Queen City Machine Tool Co., Cincinnati, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Smith & Mills, Cincinnati, O.
Springfield Machine Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Walcott & Wood Machine Tool Co., Jackson, Mich.

Shapers, Wood
American Wood Working Mchy. Co., Rochester, N. Y.

Shears, Hand
Armstrong-Blum Mfg. Co., Chicago, Ill.

Shears, Power
Bertsch & Co., Cambridge City, Ind.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Ferracute Mach. Co., Bridgeton, N. J.
Long & Allstatter Co., Hamilton, Ohio.
Manning, Maxwell & Moore, Inc., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Royersford Foundry & Mach. Co., Royersford, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Swaine Mfg. Co., Fred J., St. Louis, Mo.
Toledo Machine & Tool Co., Toledo, O.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Shears, Rotary
Bethlehem Foundry & Mach. Co., South Bethlehem, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press & Tool Co., Hastings, Mich.
Manning, Maxwell & Moore, Inc., New York.

Sheet Metal Working Machinery
Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press & Tool Co., Hastings, Mich.
Ferracute Machine Co., Bridgeton, N. J.

Shelving, Shop
Lyon Metallic Mfg. Co., Aurora, Ill.
New Britain Mach. Co., New Britain, Conn.

Slide Rests
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Betts Mach. Co., Wilmington, Del.
Blount Co., J. G., Everett, Mass.
Garvin Machine Co., New York.
National-Acme Mfg. Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Reed Co., F. E., Worcester, Mass

Slotters
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Betts Mach. Co., Wilmington, Del.
Dill Slotter People, Philadelphia, Pa.
Garvin Machine Co., New York.
Manning, Maxwell & Moore, Inc., New York.
National-Acme Mfg. Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Taylor & Fenn Co., Hartford, Ct.
Tindel-Morris Co., Eddystone. Pa.

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Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

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Automatic Mach. Co., Bridgeport, Conn.
Beaman & Smith Co., Prov., R. I.
Bilgram, Hugo, Philadelphia, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Blanchard Mach. Co., Cambridge, Mass.
Bliss Co., E. W., Brooklyn, N. Y.
Cell Drier Machine Co., Taunton, Mass.
Cleveland Cap Screw Co., Cleveland, O.
Consolidated Press and Tool Co., Hastings, Mich.

Special Machines and Tools—*Continued.*
Crescent Forgings Co., Oakmont, Pa.
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Manville Bros. Co., Waterbury, Conn.
Merritt, Jos., Hartford, Conn.
Mossberg Wrench Co., Central Falls, R. I.
Mueller Mach. Tool Co., Cin., O.
Pratt & Whitney Co., Hartford, Conn.
Queen City Machine Tool Co., Cincinnati, O.
Reinforced Brazing & Mach. Co., Pittsburg, Pa.
Smith, Chas. T., New York.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Standard Engineering Works, Ellwood City, Ind.
Swaine Mfg. Co., Fred J., St. Louis, Mo.
Taylor & Fenn Co., Hartford, Ct.
Turner Mach. Co., Danbury, Ct.
Wellman Co., Medford, Mass.

Spools, Steel
Standard Welding Co., Cleveland, Ohio.

Springs, Wire
Cleveland Wire Spring Co., Cleveland, O.

Spring Winders
Remington Tool & Mach. Co., Boston, Mass.

Sprockets
Baldwin Chain & Mfg. Co., Worcester, Mass.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cullman Wheel Co., Chicago, Ill.
Link-Belt Co., Philadelphia, Pa.
Whitney Mfg. Co., Hartford, Ct.

Stampings, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bay State Stamping Co., Worcester, Mass.
Globe Machine & Stamping Co., Cleveland, O.
Mossberg Wrench Co., Central Falls, R. I.

Stampings, Welded
Standard Welding Co., Cleveland, Ohio.

Stamps, Steel
Eastern Machinery Co., New Haven, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
Crosby Steam Gage & Valve Co., Boston, Mass.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.
Powell Co., Wm., Cincinnati, O.

Steel, Air Hardening
Bethlehem Steel Co., So. Bethlehem, Pa.
Firth-Sterling Steel Co., Pittsburg, Pa.
Nash Company, Geo., New York.
Witteman & Co., A. P., Phila., Pa.

Steel, Machinery
Bethlehem Steel Co., So. Bethlehem, Pa.
Cammell, Laird & Co., New York.
Firth-Sterling Steel Co., Pittsburg, Pa.
Morton & Co., B. K., Sheffield, England.
Nash Company, Geo., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.
Witteman & Co., A. P., Phila., Pa.

Steel, Sheet
American Tube & Stamping Co., Bridgeport, Conn.
Bethlehem Steel Co., So. Bethlehem, Pa.

Steel, Sheet—*Continued.*
Firth-Sterling Steel Co., Pittsburg, Pa.
Nash Company, Geo., New York.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
American Tube & Stamping Co., Bridgeport, Conn.
Bethlehem Steel Co., So. Bethlehem, Pa.

Steel, Tool
Cammell, Laird & Co., New York.
Firth-Sterling Steel Co., Pittsburg, Pa.
Morton & Co., B. K., Sheffield, England.
Nash Company, Geo., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.
Witteman & Co., A. P., Phila., Pa.

Steel Tempering and Hardening Solution
Metal Hardening Solution Co., Rochester, N. Y.

Stocks, Die
See Taps and Dies.

Stones, Oil
American Emery Wheel Co., Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass.
Vitrified Wheel Co., Westfield, Mass.

Stools, Shop
Cleveland Wire Spring Co., Cleveland, O.
Manufacturing Equip. & Engineering Co., East Boston, Mass.

Straightening Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fitchburg Machine Works, Fitchburg, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Springfield Machine Tool Co., Springfield, O.

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Burroughs Co., Chas., Newark, N. J.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Straighteners, Shaft
Johnson & Basset, Worcester, Mass.

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Excelsior Needle Co., Torrington, Mass.

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Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Western Electric Co., Chicago, Ill.
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Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

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Pratt & Whitney Co., Hartford, Conn.

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Keuffel & Esser Co., New York.
Lufkin Rule Co., Saginaw, Mich.
Starrett Co., L. S., Athol, Mass.

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Errington, F. A., New York.

Tapping Machines and Attachments
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Baker Brothers, Toledo, O.
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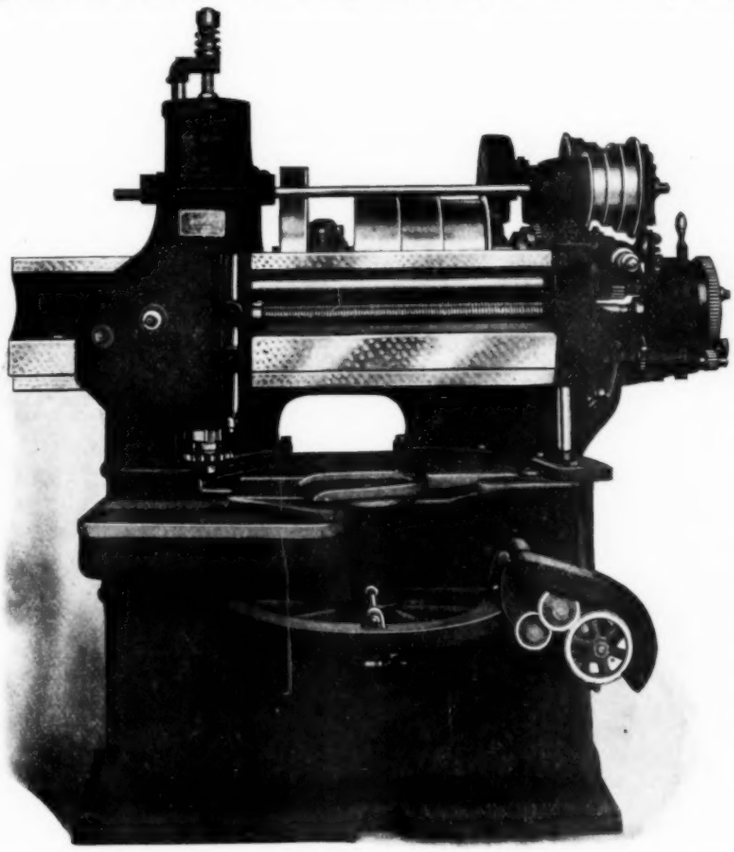

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2nd. Gear Shaper gears are accurate and run smoothly, because they are generated by a cutter, which is not only *theoretically* correct but, which is *practically* so, because ground to the accurate involute curve after being hardened. This is especially important in the case of the high speed cutter, because it springs in hardening more than the carbon. Thus the Gear Shaper cutter is extremely accurate in speed steel as well as in carbon, and therefore even when pushed to the limit, produces smooth running gears. It is thus evident what we mean by "accurate and low cost."

If you have a desirable gear or combination of gearing which cannot be cut to advantage by a rotary cutter, do not discard it until you have considered the possibilities and advantages of a planing tool.

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Geometric Tool Co., New Haven, Conn.

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Pratt & Whitney Co., Hartford, Conn.
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Tools, Small
See Machinists' Small Tools.

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Dreses Mach. Tool Co., Cin., O.
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Gisholt Mach. Co., Madison, Wis.
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Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

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Whitman & Barnes Mfg. Co., Chicago, Ill.
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Lunkenheimer Co., Cincinnati, O.
Nolte Brass Co., Springfield, O.

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Vises, Drill
Graham Mfg. Co., Prov, R. I.
Plunket, J. E., Chicago, Ill.

Vises, Metal Workers'
Athol Machine Co., Athol, Mass.
Emmert Mfg. Co., Waynesboro, Pa.
Hammacher, Schlemmer & Co., New York.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Millers Falls Co., New York.
Parker Co., Chas., Meriden, Conn.
Pittsburg Auto. Vise & Tool Co., Pittsburg, Pa.
Plunket, J. E., Chicago, Ill.
Prentiss Vise Co., New York.
Reed Mfg. Co., Erie, Pa.
Rock Island Tool Co., Rock Island, Ill.
Williamson Vise Co., Bradford, Pa.

Vises, Pipe
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
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Williamson Vise Co., Bradford, Pa.

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Cincinnati Planer Co., Cincin., O.
Hendey Mach Co., Torrington, Conn.
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Queen City Machine Tool Co., Cincinnati, O.
Williamson Vise Co., Bradford, Pa.

Vises, Universal Machine
Graham Mfg. Co., Prov., R. I.

Vises, Wood Workers'
American Wood Working Mchry. Co., Rochester, N. Y.
Hammacher, Schlemmer & Co, New York.
Parker Co, Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.

Vise Stands
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Tindel-Morris Co., Eddystone, Pa.

Voltmeter
Bristol Co. Waterbury, Conn.
Weston Elec. Instrument Co., Newark, N. J.

Washers
Milton Mfg. Co., Milton, Pa.

Wash Stands
Lyon Metallic Mfg. Co., Aurora, Ill.
Mfg. Equip. & Engineering Co., East Boston, Mass.

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Nash Company, Geo., New York.

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Smith, Chas. T., New York.

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National Machinery Co., Tiffin, O.

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Prentiss Tool & Supply Co., New York.

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American Wood Working Mchry. Co., Rochester, N. Y.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
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Williams & Co., J. H., Brooklyn, N. Y.

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Hammacher, Schlemmer & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
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Whitman & Barnes Mfg. Co., Chicago, Ill.
Williams & Co., J. H., Brooklyn, N. Y.

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Patterson, Gottfried & Hunter, Ltd., New York.
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Williams & Co., J. H., Brooklyn, N. Y.

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Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Tap
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Hart Mfg. Co., Cleveland, O.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.